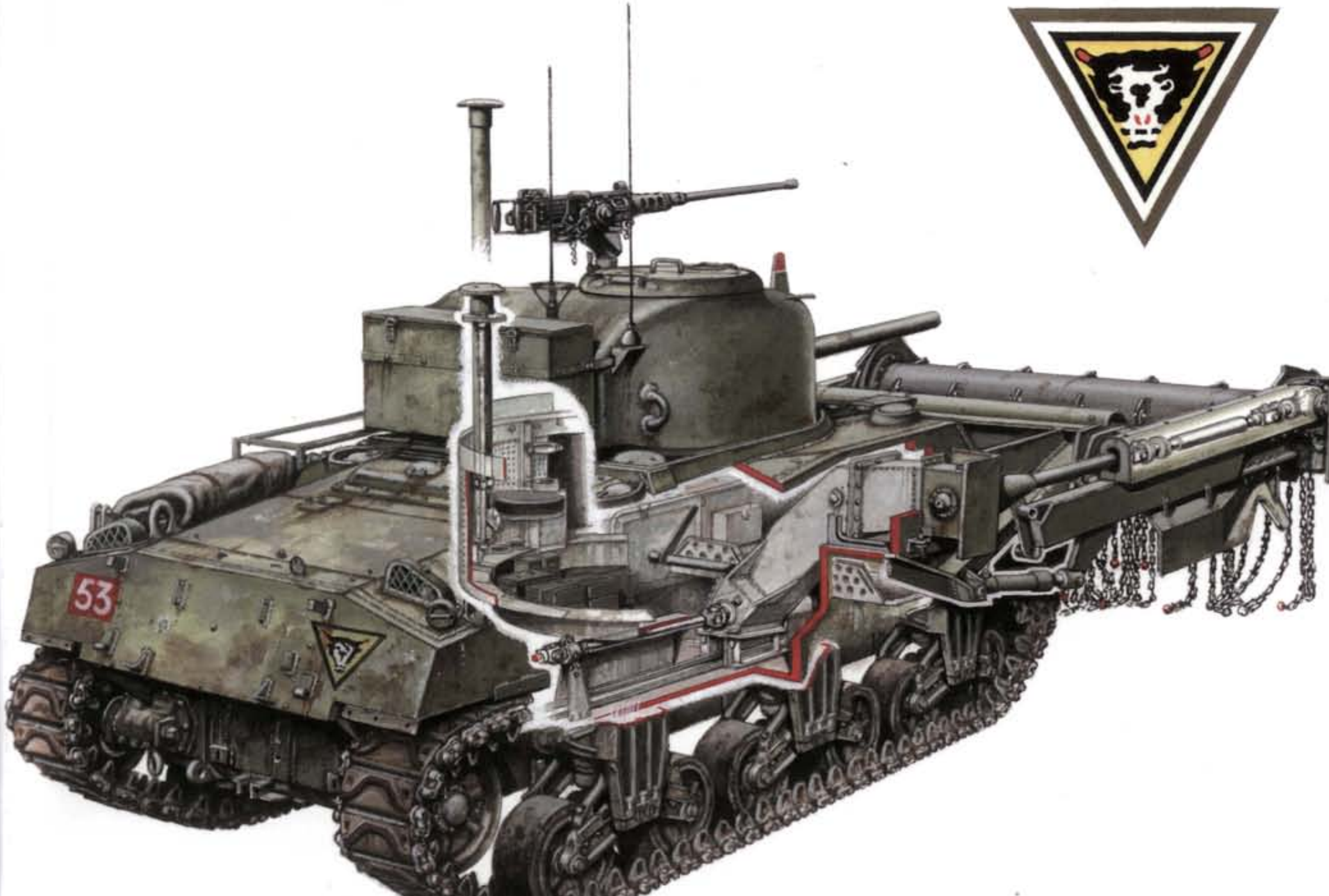
New Vanguard

OSPREY
PUBLISHING

Sherman Crab Flail Tank



David Fletcher • Illustrated by Tony Bryan

DAVID FLETCHER was born in 1942. He has written a number of books and articles on military subjects and is currently the historian at the Tank Museum, Bovington, UK. He has spent over 40 years studying the development of British armoured vehicles during the two World Wars.

TONY BRYAN is a freelance illustrator of many years' experience who lives and works in Dorset. He initially qualified in Engineering and worked for a number of years in Military Research and Development, and has a keen interest in military hardware – armour, small arms, aircraft and ships. Tony has produced many illustrations for partworks, magazines and books, including a number of titles in the New Vanguard series.

CONTENTS

INTRODUCTION 3

- Born in the desert

ALAMEIN DEBUT 6

DEVELOPMENTS IN BRITAIN 7

- Enter the Baron
- The British Scorpion

PROTOTYPES PROLIFERATE 15

THE SCORPIONS SPREAD 19

THE CRABS MOVE IN 33

- The Crab in action

THE AMERICAN ANGLE 40

POST-WAR DEVELOPMENTS 41

BIBLIOGRAPHY 44

COLOUR PLATE COMMENTARY 45

INDEX 48

New Vanguard • 139

Sherman Crab Flail Tank

David Fletcher • Illustrated by Tony Bryan

First published in Great Britain in 2007 by Osprey Publishing,
Midland House, West Way, Botley, Oxford OX2 0PH, UK
443 Park Avenue South, New York, NY 10016, USA
E-mail: info@ospreypublishing.com

© 2007 Osprey Publishing Ltd.

All rights reserved. Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the Copyright, Designs and Patents Act, 1988, no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, electrical, chemical, mechanical, optical, photocopying, recording or otherwise, without the prior written permission of the copyright owner. Enquiries should be addressed to the Publishers.

A CIP catalogue record for this book is available from the British Library

ISBN: 978 1 84603 084 0

Page layout by Melissa Orrom Swan, Oxford
Index by Alan Thatcher
Typeset in Helvetica Neue and ITC New Baskerville
Originated by PPS Grasmere Ltd, Leeds, UK
Printed in China through Worldprint Ltd.

07 08 09 10 11   10 9 8 7 6 5 4 3 2 1

For a catalogue of all books published by Osprey Military and Aviation please contact:

NORTH AMERICA
Osprey Direct, c/o Random House Distribution Center, 400 Hahn Road,
Westminster, MD 21157
E-mail: info@ospreydirect.com

ALL OTHER REGIONS
Osprey Direct UK, P.O. Box 140 Wellingborough, Northants, NN8 2FA, UK
E-mail: info@ospreydirect.co.uk

www.ospreypublishing.com

Author's note

The author wishes to thank John Taylor-Firth, Ian Hammerton, and Richard C. Harley.

All images contained in this book are kindly provided by The Tank Museum, Bovington.

THE SHERMAN CRAB FLAIL TANK

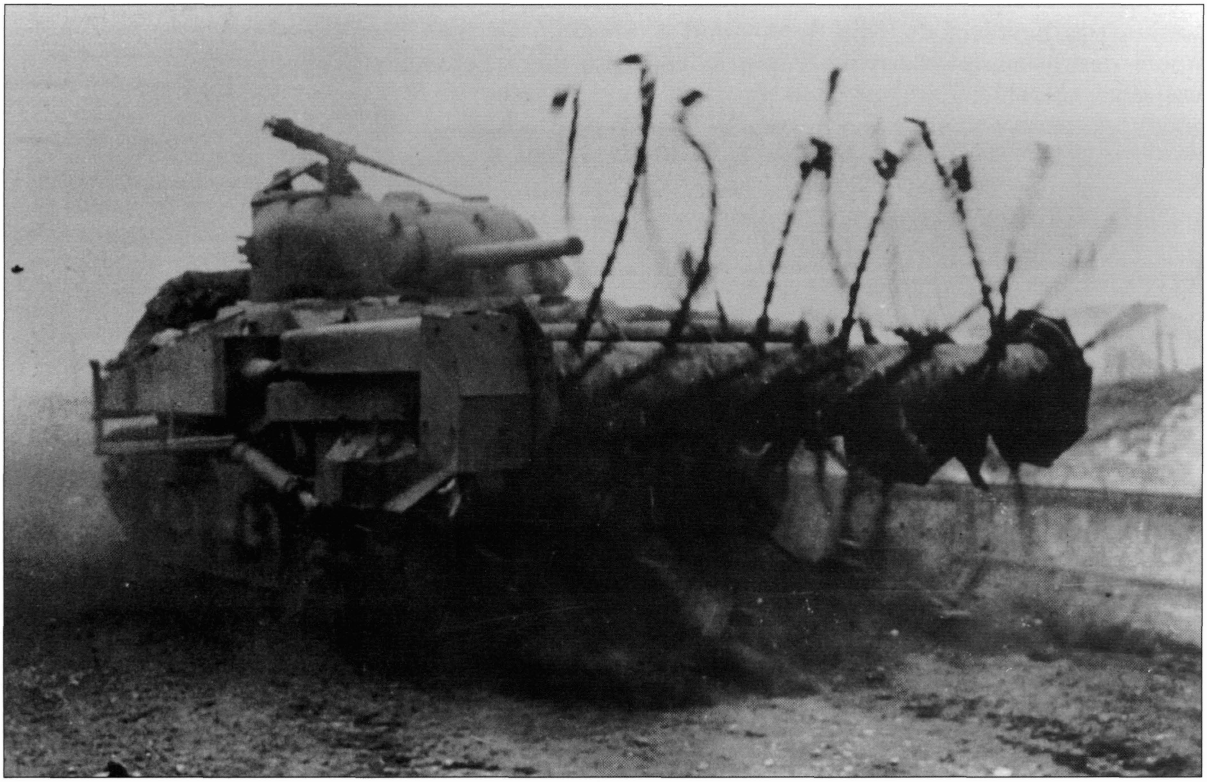
INTRODUCTION

Most readers will know that the Western Desert is meant to be a 'tactician's paradise', an open expanse in which the gifted commander can exercise his skills to outmanoeuvre his opponent. Even so, this is only true in a limited sense. There are all manner of natural features in the desert that inhibit what a commander can do, and the sensible soldier improves upon these with man-made ones, among which the minefield is the most effective. Well sited, the minefield can turn vast swathes of desert into no-go areas for mobile forces and channel them elsewhere at the dictates of the defender. For the Allied armies operating in the theatre during World War II, some system or machine had to be created to counter the threat of mines.

Born in the desert

When Rommel took Tobruk in June 1942, the British and Allied forces began a massive retreat back over the Egyptian frontier, hoping to reach

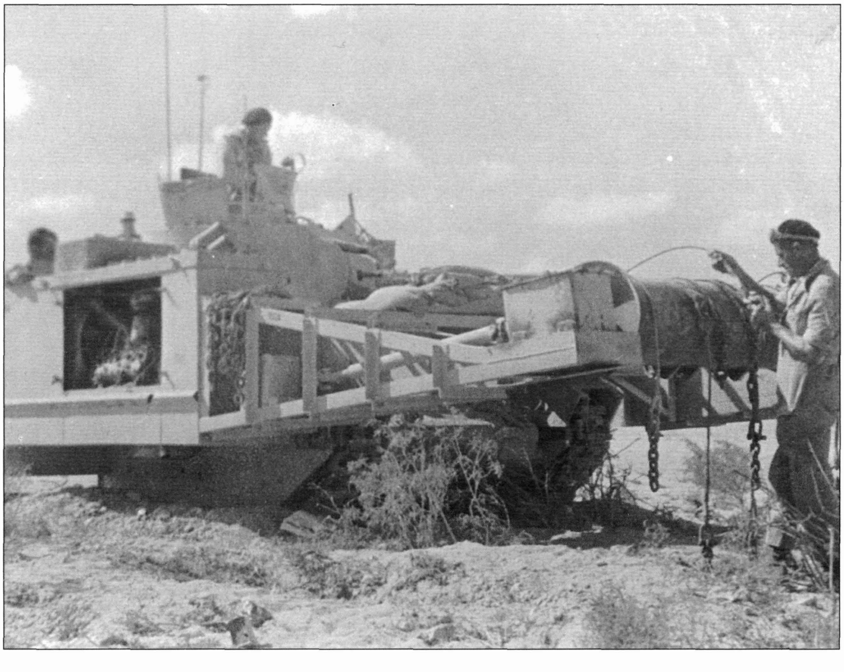
A Crab going all-out. This photograph is presumably a training picture since there are no markings on the tank and no photographer with any sense would stand just here if there was any risk of a mine going off.



Cairo and Alexandria before the Germans did. Among them was a British workshop unit (No.4 Ordnance Workshop) that had been based, until this time, at Buq-Buq near the coast, and which had with it a very strange vehicle. Carried in the back of a Canadian Ford lorry was another Ford chassis, shortened somewhat although still retaining the engine, transmission and rear axle. At each end of the axle, where the wheels might have been, were drums, from which hung lengths of wire rope and chain – it was, in effect, the original anti-mine flail. In action the shortened chassis would be suspended from the front of the regular lorry like a jib, but facing back to front so that the flail drums were at the forward end where they beat the ground to explode mines in the path of the vehicle.

The officer responsible for this piece of work was Major Norman Berry, then Assistant Director of Ordnance Stores (ADOS) at HQ XIII Corps. A year earlier, in September 1941, Berry had been ordered to Pretoria to examine a South African proposal for a mine-sweeping flail device described as a threshing machine. He was introduced to a Captain Abraham du Toit and shown a short colour film of the contraption in action. It appealed to Berry and he suggested that work should begin at once, preferably at a desert workshop where secrecy could be maintained, but this was overruled. Instead du Toit, as the inventor, was to go to Great Britain and pursue his work there. Berry went back to the desert; du Toit departed for London on 14 October 1941 with details of what General Claude Auchinleck described as an Anti-Tank Mine Springing Device.

Berry found this all very frustrating. He was sure the concept could be made to work, but he heard nothing more. He pestered everyone he could find. Visiting officers from Britain, particularly those with a technical background, were his favourite targets, but nobody had so much as heard of du Toit, never mind a threshing machine that would destroy mines. Berry's decision to continue the experimental



A useful view of a Matilda Scorpion I preparing for action. The commander is in his cupola, one crew member is checking the joints on the wire and chain flails, while the flail operator is in his engine box on the side.

work unofficially was interrupted by Rommel's latest attack, and when No.4 Workshop arrived in the Alamein area they were simply too busy patching up damaged tanks to do any more with the threshing machine. Rather than write the project off, Berry found a South African unit (21st Field Company, South African Construction Company) with manpower to spare and handed it over to them.

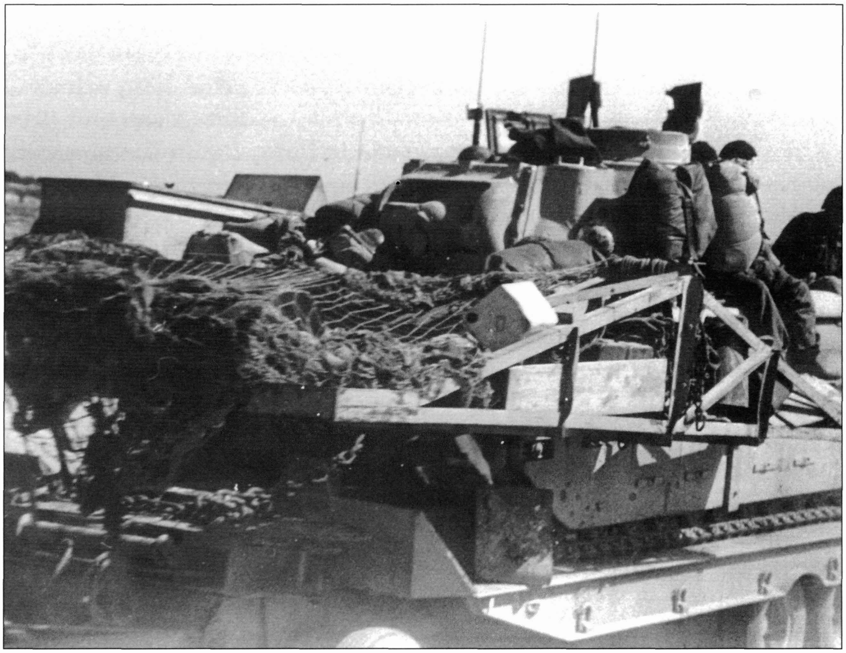
Although the lorry chassis had worked up to a point, Berry believed that a full-width rotating drum would prove a better proposition than narrower ones on each side, and with the injunction that they must use only standard vehicle components, he set a mixed Royal Engineers (RE) and Royal Electrical and Mechanical Engineers (REME) team on the project, for which an A12 Matilda Infantry Tank was delivered early in August 1942.

Little is known of the problems that the engineers faced, but something over a month later the tank flail was completed and, on 13 September, it was recorded as having passed its final test. One trial involved comparison with a Matilda equipped with Fowler Rollers (see New Vanguard 8, *Matilda Infantry Tank 1938–45*) and the flail proved to be so much better that, in Berry's words, the rollers were 'dropped as being useless in comparison with the Threshing Machine'. It must have impressed others besides Berry, because in mid-September the Eighth Army commander (by now General Montgomery) announced that he required 24 of them in four weeks' time.

The work was to be done by No.7 Base Ordnance Workshops in Alexandria and they would require proper drawings, not the back-of-an-envelope plans that Berry and his men had been working on hitherto. Berry was also on the lookout for a more powerful engine. The original Ford V8 was underpowered, but attempts to find Berry's preferred choice, a V-12 Lincoln Zephyr, were not successful. The code name 'Scorpion' was adopted when the original choice of 'Durban' was rejected.

If the task of getting the work done on the 24 Matilda tanks was difficult in the time allowed, it was no easier finding crews for them. Two battle-worn regiments, 42nd and 44th Royal Tank Regiments, were combed for crews with Matilda experience, while the RE was to supply the flail operators. This latter position was no sinecure. It meant occupying a cramped position within a box on the right side of the tank, which also contained the flail engine, radiator and drive system. Despite the fact that at least one Sapper NCO described it as preferable to finding and lifting mines by hand under fire, that is not saying very much. Not only was there more noise and heat than the average man could bear, it was also found necessary to wear a gas mask during flailing operations in order to filter out the dust.

Having acquired the tanks, or at least most of them, just in time, and General Montgomery's enthusiasm notwithstanding, it was still not easy to sell the concept to some corps and divisional commanders. Many feared that as experimental devices on old and unreliable vehicles, the flail tanks were likely to break down and block such routes as they had cleared. It was not an unqualified judgement; pre-battle demonstrations had been blighted by failures. However, to the south 7th Armoured Division welcomed them. Perhaps it was due to the fact that they were eager to pass through a minefield in order to get at their old adversaries, 21st Panzer Division.



A Matilda Scorpion II heading west on a transporter. The flail apparatus is camouflaged, but the nearside arm can be seen, along with the engine box on the far side.

ALAMEIN DEBUT

It is an unfortunate fact that the two regiments earmarked to take these new devices into action for the very first time make little of it in their histories. As a result, most contemporary comments come from other sources, the majority of whom were not aware of the difficulties these crews were facing and were only too ready to write them off as failures.

There was no previous experience to go on, so the plan, thrashed out on the eve of the battle of El Alamein in October 1942, was probably not as effective as it might have been. One idea, to send all the available flails across in one area to sweep a wide route, was rejected at the outset due, presumably, to its practical limitations. In most areas the Scorpions were simply ordered to flail a route through the minefield and then turn round to widen it on a return run. Only in the 7th Armoured Division's area was a more structured plan produced, which saw the Scorpions operating in company with Sappers on foot and other vehicles. Available figures indicate that between 12 and 15 Scorpions were in a fit state to take part, of which six would be allocated to 7th Armoured Division.

According to the British official history, the sight of a Scorpion flailing through soft sand 'had to be seen to be believed' and there were those on the opposite side who wondered what on earth was coming. Huge clouds of dust, giving off loud mechanical noises and the occasional explosion, were all that could be seen. Not that it was a continuous threat. Even the best of the Scorpions could not keep up flailing for very long. Dust choked the air intake of the flail engine and it soon got so hot that petrol was vaporizing before it even reached the carburettor; at which point the engine stopped. Then there was nothing to do but sit and wait while it cooled down, to see if it might start again. Many tanks also suffered mechanical breakdown from other causes and, although no figures can be traced, it seems that a high percentage only ever managed a one-way crossing of the minefield, if that. A mere handful were fit enough to tackle the return run.

Discussion after the battle revealed a number of shortcomings with these pioneering Scorpions. The lattice girder arms that supported the rotor were not strong enough, air cleaning for the flail engine had to be improved and the wretched Sapper needed to be located somewhere else to save him from the purgatory of the engine housing. All of these matters were resolved, up to a point. The lattice girder arms were improved; better air filters were installed; the Sapper, with his controls, was moved into the tank's turret. Experience had shown that among the Scorpion crews the most under-employed individual was the gunner, who could not see to shoot at anything. He was therefore removed, along with the ammunition and the gun itself. The commander was retained, obviously, while the loader was still able to act as wireless operator and fire the co-axial machine gun.

In this form came the Scorpion II – the simplest way to identify it from the original model is to see whether it has a gun or not. Another clue is to look at the set of the turret. If it is traversed somewhat to the left of the centre line, say at 11 o'clock in gunnery terms, then the chances are it is a Mark II because this position was best for the flail operator. But to be absolutely sure, look at the boom support arm on the left side of the vehicle: if it looks like two triangles, tapering off fore and aft from the centre it is a Mark II. If it is square at the rear end then it is a Scorpion Mark I.

DEVELOPMENTS IN BRITAIN

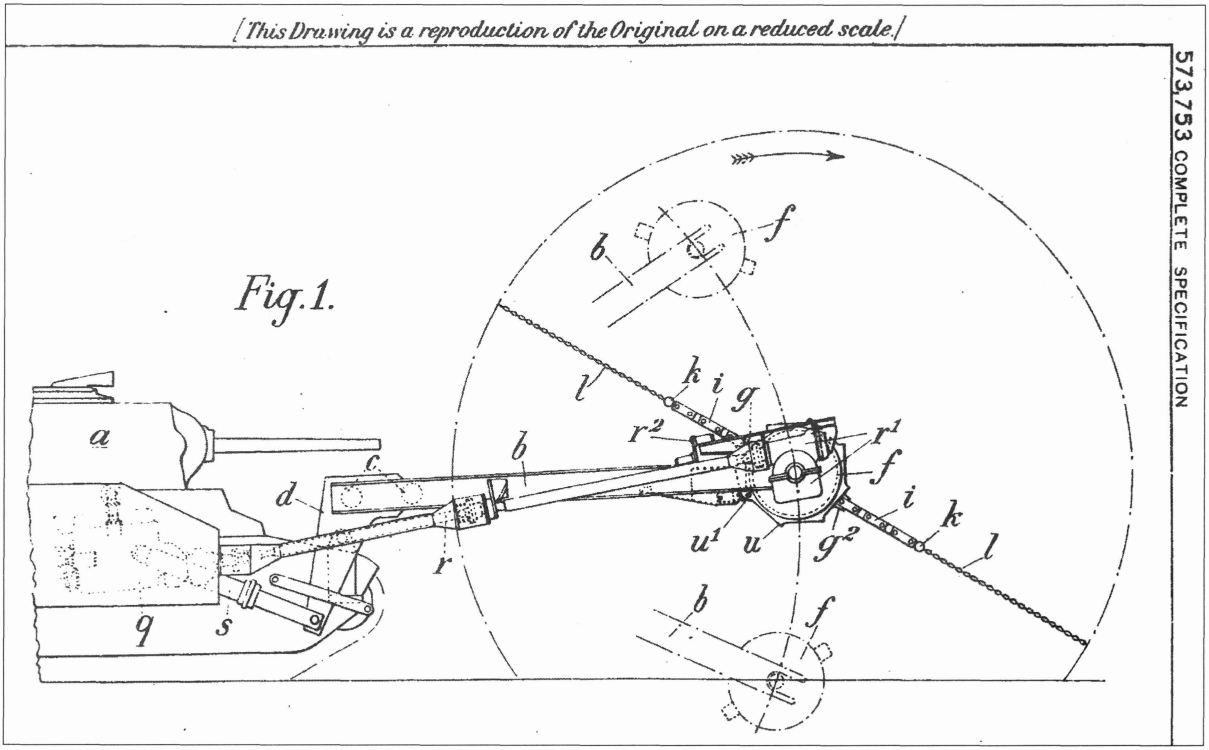
Abraham du Toit arrived at the War Office in London with General Auchinleck's endorsement in his pocket. Although effectively now working with the Department of Tank Design (Special Devices) section he was based, for most of the time, at the Southall Works of the Associated Equipment Company Ltd (AEC), the 'Builders of London's Buses' as they liked to style themselves. In fact, the company's customer base was far broader than that title suggested, embracing an extensive range of commercial and military vehicles as well as buses, coaches and railcars. It was a thriving organization with progressive attitudes and a very talented design team headed by one of the most brilliant mechanical engineers of the day, George J. Rackham. Rackham had so many strings to his bow that they cannot all be covered here, but it should be noted that he had been a Tank Corps officer on the design side in World War I and, in addition to his later work on flails, was also heavily involved in the design of armoured flamethrowers (see New Vanguard 136, *Churchill Crocodile Flamethrower*). It is in the matter of flail design that he was destined to make what was probably his most significant contribution to the British war effort, although he would still be involved with matters of tank design after the war.

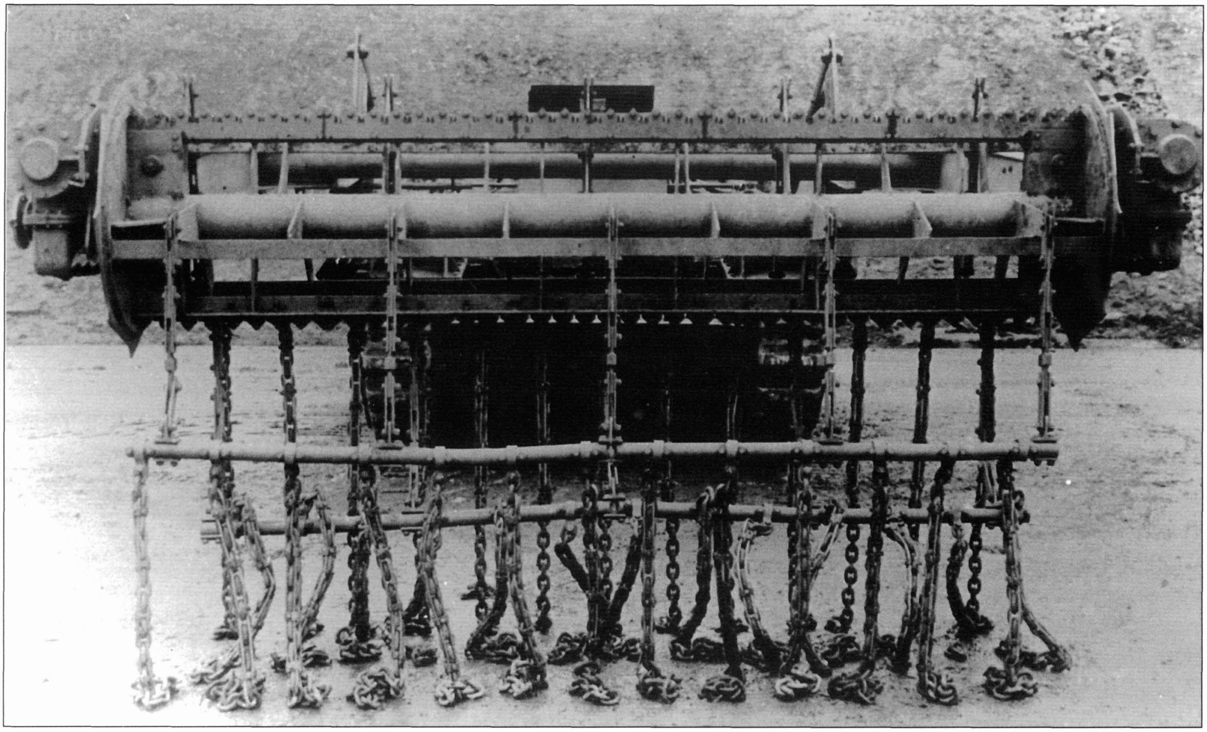
While it is entirely fair to say that du Toit was the inspiration for flail development in both the Middle East and United Kingdom as it ultimately appeared, he was by no means alone. The earliest design of which we have details was drawn by a Captain O'Shaughnessy in November 1939 and shown to Major S. G. Galpin at Bovington, the centre of tank activity in Great Britain, in May 1940. In fact it was one of two, the first being a relatively conventional motor-driven flail, the other a system of rollers, pushed ahead of the tank, with sprung beaters that thrashed the ground. In a covering note Galpin says that O'Shaughnessy's device is 'similar to those which have been put forward in the past'. At about the same time Galpin was shown another design by a Mr G. J. Sutton, a civilian member of the War Office Anti-Tank Mine Committee. Later, in September 1942, a Major Paterson submitted a flail device for attachment to British Cruiser Tanks, notably the Covenanter and Crusader, which was driven by a pulley arrangement from the front idler wheels. Paterson claims that Galpin himself had come up with a workable flail design but made no effort to claim any reward for it, since he regarded it as his duty. No doubt there were many more that failed to leave even this modest evidence.

Enter the Baron

Known, initially, as the 'du Toit Winch', the Matilda-based flail tanks developed in Britain were rechristened 'Barons' in February 1942. Like its Middle Eastern counterpart, the British prototype retained its turret and mounted a separate engine compartment, in this instance containing a Chrysler unit, on the right side of the hull. The engine was housed in an armoured box, situated in line with the turret, from which a drive shaft extended forward into a small gearbox. Here motion was translated to a sprocket which, by means of a long loop of chain, activated another sprocket on the end of the rotating flail drum. The big difference from Scorpion was that the arms supporting the rotor drum could be raised hydraulically, using the turret traverse mechanism, to keep the chains clear of the ground when they were not needed.

Patent diagram for the second Matilda Baron prototype showing the drive arrangement, arc of movement of the rotor and rotational direction and diameter of the two sets of flails.


[This Drawing is a reproduction of the Original on a reduced scale.]
573,753 COMPLETE SPECIFICATION
Fig.1.
a
b
c
d
f
g
i
k
l
r
r²
r¹
u¹
u
g²
q
s



Matilda Baron Mark IIIA viewed from the front to emphasize the width. Seen like this, one can examine the complicated rotor and flail arrangement, the serrated teeth of the wire cutters and the drive at each end of the rotor.

It is worth recording that the prototype Baron was first demonstrated on 6 June 1942, not only two years to the day before D-Day but a good two months ahead of the prototype Scorpion in the Middle East. It was viewed by the General Staff and their impressions reported to the Commander-in-Chief Middle East, General Auchinleck, who was at least aware of it, even if Norman Berry was not. The difference was that with a major battle pending those in the Middle East were happy to go with what they had got and improve upon it afterwards, whereas in the UK they wanted something better before committing it to battle.

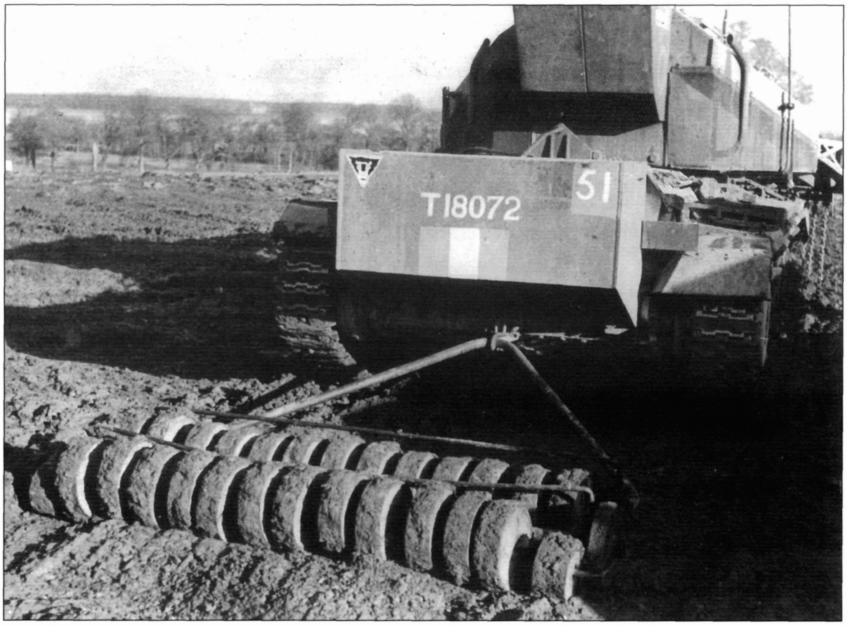
The immediate result of the prototype Baron demonstration, issued four days later, was a complaint that the Matilda seemed to be overloaded and that the flail drive engine was not powerful enough. Thus the tank was rebuilt, with a 73hp (54kW) Bedford MW engine instead of the Chrysler, and Cardan shafts replacing the chain. The hydraulic system (turret traverse) was retained and one source claimed that this enabled the operator to adjust the rotor height to suit different types of ground. However, another commentator was at pains to explain that this should not be seen as an early example of contouring. On both prototype Barons the complicated arrangement of bars and chains that made up the flails were limited to two sets, so that with every rotation the ground was only struck twice. The need for more flails was fully understood, but a good deal more power would have to be applied before this could be done.

Between June and November 1942 du Toit came up with the idea of a self-contained flail device, on rollers, that could be pushed across a minefield by any tank. A crude sketch is all that survives, but the official description claims that a form of box on wheels, propelled by the tank, contained two engines with an operator sandwiched between them. Some sort of boom extended forward from this box to a rotor, but the precise arrangement is not clear. Often referred to as a Perambulator Device it was, briefly, everyone's favourite and on a much higher priority than the conventional flail. It vanished just as swiftly at the design stage, as did a wheeled version of the Baron, presumably for armoured cars; it was noted at an Armoured Fighting Vehicles (AFV) Liaison Meeting of 9 November 1942 that: 'Baron on wheeled vehicle not to be proceeded with'.

Reading between the lines, it appears that Rackham and du Toit differed on future flail development. Rackham, at least at this stage, probably favoured a dedicated mine-clearing vehicle, while du Toit seems to have preferred the perambulator system that could be applied to any tank. At least, in a statement released at the end of the war, the South African engineer implies that while he saw a future for the 'pram' he magnanimously put it aside in order to co-operate with Rackham.

The result was the Baron Mark III, about which we have very little information. All we are told is that in its production form, as the Baron Mark IIIA, it incorporated a number of improvements, particularly in respect of the hydraulic arrangements. Thus it seems safe to assume that in general appearance the two were much the same. It is fascinating to observe how certain trends appeared at the same time in both Britain and the Middle East and this one, of a dedicated mine-clearing device with no other offensive capabilities, is a case in point.

On the production version of the Baron IIIA the entire turret assembly of the Matilda was removed and replaced by a fixed superstructure, stepped upwards from the front, which housed the flail operator with the vehicle commander above and behind him. The flail operator had one forward-facing periscope, the vehicle commander had two, looking each way, but all three periscopes could be rotated and withdrawn into the vehicle for cleaning. Access for both operator and commander was via a two-flap hatch in the roof, but ahead of them in the usual place, sat the driver with his own hatch. The official handbook uses the term 'Pannier Fashion' to describe how the two Bedford engines, each with its clutch



Viewed from the rear this Valentine Scorpion displays the markings of the 22nd Dragoons, 79th Armoured Division, and is towing a set of Centipede rollers. The markings are painted on the counterweight box, and one can also see the exhaust pipes from the auxiliary engines.

and modified gearbox, were mounted on either side of the tank, but it is worth remarking that although these units were contained within armoured covers, they were open to the air at the bottom to improve cooling and, presumably, to reduce weight.

The driver's main job during a flailing operation was to keep the tank on a dead straight course, creeping forwards at just ½mph (0.8km/h) and, through the muck thrown up by the flails and intermittent explosions, attempting to keep station on the other flail tanks of his troop. The commander's role was clearly one of overall supervision, but it was the flail operator who really had his work cut out. He probably had more controls to juggle with than the driver, in addition to operating the No.19 wireless set installed on his left. Even so, as the handbook points out, a close understanding between the three crew members was essential if the job was to be done properly.

Without getting too bogged down in technical matters, it is important to explain that although two engines were used to power the flail, each with its own starting and cooling system as well as its own clutch and gearbox, the two engines were, in effect, operated as one. The flail gearboxes had been modified to run on first, second and reverse gears only but, from the operator's point of view, this involved just one gear lever, one clutch pedal and one throttle each for the hand and foot. A series of four jointed Cardan shafts from each engine powered the rotor by means of a worm drive at each end of the shaft. Nothing is said, either in the handbook or elsewhere, about any discrepancy of power between the flail drive engines (presumably this was negligible if the two units were tuned precisely), nor what happened if one engine failed.

The rotor itself was the typical Baron type with a central tube of 6in. (15.2cm) diameter surrounded by a framework to which three banks of chains were attached. The ideal flailing rate was around 80rpm, indicated by an engine speed of 1,200rpm. However, by this time two other roles had been envisaged for the Baron. One was wire-cutting, for which purpose a mechanical cross-cutting device, acting more or less on the same principle as hair trimmers, could be activated from the operator's cab. Used in conjunction with rotary side cutters, this operated at first-gear speed, catching and chopping up the barbed wire as it went. There were limitations; too much wire could choke it and if mines were also present, the handbook noted that the tank should only advance into the wire as far as the rotor extended from the front of the tank, about 10ft (3m), then withdraw and flail over the same ground. It was also possible to use the rotor as a crude device for breaking up ground. With the rotor lowered to ground level and rotated slowly until the flail chains were wrapped around it the rotor then proceeded to chew up the ground and wear away obstacles such as anti-tank defences. The driver was supposed to move the vehicle gently to and fro a short distance while this was going on. The process was described by one witness as 'somewhat akin to the scratching of a dog'.

The failure of the first hydraulic system, run from the tank's original turret traverse gear, encouraged Rackham and his team to develop something stronger, with a separate hydraulic pump driven off each flail engine. Operating via a common reserve oil tank and a control unit in the operator's compartment, the pumps were used to activate big hydraulic jacks that raised and lowered the rotor booms as required. Some reasons for raising and lowering the rotor have already been described. Another would be in order that the tank could drive in the normal way without the flail chains touching the ground and it would also cut down storage space if the Barons could be parked with the boom from one overhanging the engine deck of the vehicle in front.

Illustrations in the handbook suggest that a good deal of the hydraulic plumbing around the control cab was woefully exposed to potential damage when the vehicle was clearing mines or under fire, but these may show a pre-production machine. It does, however, seem clear that on the Baron IIIA the operator was expected to exploit the easy movement of the booms by following contours in the ground so that deep hollows might not be missed and bumps not struck by the rotor. Operators were informed that a height of about 4ft 6in. (1.4m) was best for the rotor (given that the flail chains were not damaged) in order that each chain would strike the ground at around 60mph (96.5km/h), which was sufficient to detonate a German anti-tank mine buried up to 4in. (10.2cm) in the ground.

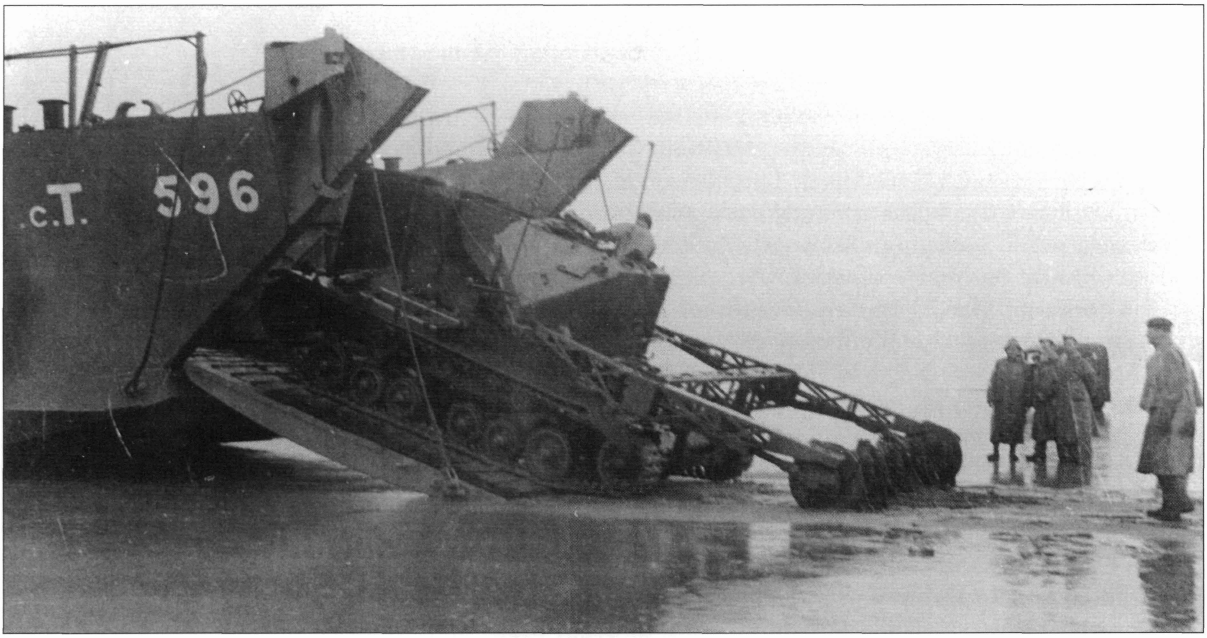
The greatest drawback to the Baron was, with an engine at each side, its overall width of 13ft (4m). This prevented it from crossing a normal Bailey Bridge or from passing through the bow section of a contemporary landing craft, both serious operational limitations. In addition, as the handbook explains, it was a logistics nightmare since for transportation, presumably by rail, both flail engines had to be removed, as did the rotor, rotor arms (in four pieces), along with the Cardan shafts and gears.

One experiment, which theoretically would have applied to all flails, was the idea of rotating the chain drum in the opposite direction, that is to say anti-clockwise if one were watching the tank from the right. Trials suggested that reverse flailing gave a higher percentage of detonations but, since these now happened a lot closer to the tank than with conventional rotation, the practice was abandoned. It is also worth remarking that with the flail going round in the regular way there were instances of live mines being thrown up by the chains and landing on top of the tank. Generally this was not a problem even if the mine detonated, so long as the crew were totally closed down.

Production of the Baron IIIA was placed in the hands of Curran Brothers of Cardiff in 1942. They were given an initial contract for 60 conversion kits with a promise of 60 more to follow. The idea was that the kits would be delivered to Matilda battalions earmarked for conversion. These would then be visited by travelling teams of trained fitters working in conjunction with local REME workshops. Space had been arranged to ship a dozen Baron IIIAs to the Middle East, but they could not be completed in time and, as far as is known, none ever went abroad. Some were issued to No.1 Assault Squadron Royal Armoured Corps (RAC) which, on 29 July 1943, was placed under command of General Hobart's 79th Armoured Division where it was ultimately absorbed into 43rd Royal Tank Regiment, which became the division's experimental trials unit.

The British Scorpion

At least two quite separate factors influenced subsequent developments both in Britain and the Middle East. First was agreement that by 1943 the Matilda was too slow for the work; not for flailing itself, which was a slow process at the best of times, but in the ability of the device to move into action at the pace of other vehicles. Second was a growing appreciation



A rainy day at Westward Ho! and a Valentine Scorpion III reverses up the ramp of a dried out Landing Craft, Tank (4). Deep wading gear has been erected behind the superstructure, so a wet landing is contemplated.

in both theatres that, sooner or later, the Allies would become involved in amphibious operations for which existing types of flail were unsuitable on account of width.

Also, by this time there had been some exchange of information between flail tank users in Britain and the Middle East, as a result of which AEC was tasked with investigating a new design to incorporate the best of both systems, mounted on a more up-to-date tank hull. The type selected was the Infantry Tank Mark III, or Valentine, and the Director RAC had 120 of the diesel-powered Mark II types set aside for conversion.

Following two prototypes, a contract was issued to AEC for a production order that appeared to grow steadily as the requirement for the type was re-evaluated. Even so, the design was not without its limitations. The Service Instruction Book for the Scorpion indicates that hulls of both the Valentine II and III could be employed, although in practice these were the same – the difference lay in the type of turret fitted but, since that was removed as part of the conversion process, this was academic. Both versions were powered by the AEC 131hp (96kW) diesel engine.

Since vehicle width was now a significant factor, the two auxiliary engines, Canadian Ford V8 petrol units rated at 82bhp (61kW), were housed in a curious, six-sided structure that replaced the turret. The exact shape is difficult to judge, even from photographs, but in essence it consisted of a central box of welded construction and armoured to a maximum of ½in. (14mm). It contained two members of the crew, the vehicle commander and the flail operator. In action they stood upright, side by side with the commander on the left, viewing the world through a pair of standard tank periscopes. They shared this cramped compartment with a fuel tank for the two flail engines and a No.19 wireless set, which rested on top of the fuel tank. On the front wall, ahead of the flail operator, were the controls for the two Ford engines: separate starter buttons, a single tachometer for both engines and a single throttle control by Bowden cable. Lower down was a single clutch pedal and a lever to engage the gearbox. There were access hatches in the roof of this box, although the commander and operator had the option of crawling through to or from the driver's exit hatches.

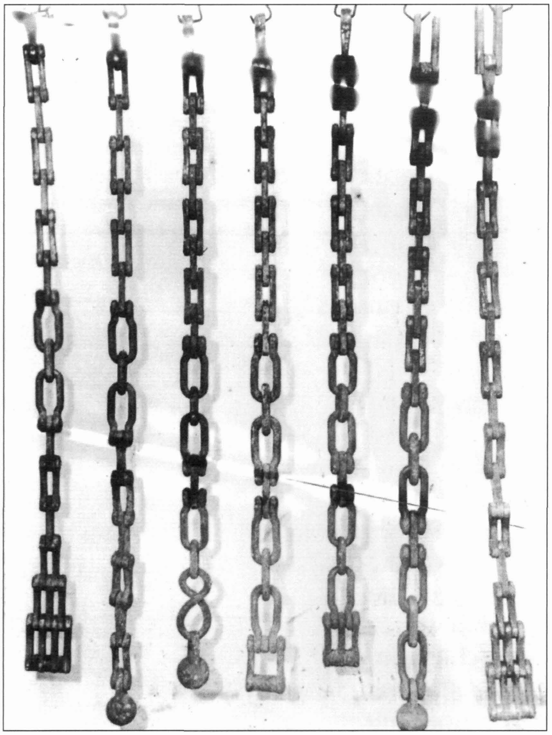
The engines were housed in lockers on either side of the central box, the lockers being triangular in shape and fitted with overhead hatches so that the engines could be serviced. They were not mounted in line with the vehicle but set at odd angles so that universal joints on the Cardan shafts were vital. Each engine was attached to a single-speed gearbox and, as with the Baron, the controls were unified and under the control of one operator. Placing the engines either side of the central superstructure must have made it uncomfortably noisy for the two men inside, but of course it reduced the overall width of the vehicle and eliminated the need for external plumbing.

In a sense, the only true Scorpion feature of this design was the lattice arrangement of the rotor arms and the cross-member that braced them. The drive system was based upon the later Baron and the rotor itself was also of the Baron type, although the flail chains were Scorpion style with 32 sets of independent links with no secondary connections. Unlike the Baron there was no hydraulic equipment to elevate or depress the rotor arms, so that earth moving – and wire cutting to begin with – were not options. The lattice arms were pivoted to the superstructure, but vertical movement was limited to four positions marked by bolt holes in two upright girders, known as 'goal-posts', attached to the front of the tank. Since all of these flail devices created a lot of additional pressure on leading suspension units, an attempt was made to even this out, in the case of the Valentine Scorpions, by fitting a large open tray at the back which, of itself, acted as a counterbalance weight to the booms and rotor. It was also used to hold spare flail chains.

The Valentine Scorpion was, by any standards, an ungainly looking machine and to make matters worse it was attended with tragedy. Unlike the final Baron design it does not appear that the flail engines were equipped with reverse gears. Even so, in one live trial at the Obstacle Assault Centre in May 1943, it seems that the tank reversed over two live German mines, one of which was detonated by the flail while the other went off in sympathy directly under the hull of the tank, causing the deaths of all three members of the crew. This event led to a demand for more protection beneath the tank, but the amount of armour required also created a weight penalty that was unacceptable.

News from the Middle East now drew attention to the fact that the enemy had started sowing mixed minefields of Teller anti-tank mines and the anti-personnel S-mine, but that, for some reason, flails had no effect upon the latter. Since this could prove disastrous for human mine clearers and following infantry, the Scorpion was also tested towing a device called Centipede, which consisted of multiple, tiny rollers and this is said to have worked reasonably well in detonating the anti-personnel mines.

A firm named T. C. Jones & Co., in the unlikely surroundings of Shepherds Bush in London, became the design parents for Scorpion III and the plan was to send them the conversion kits, which they assembled to be mounted on Valentine hulls at the Chilwell Ordnance Depot. Various figures have been bandied about as to numbers, anything from 125 to 300, but it seems that production was painfully slow. As far as 30th Armoured Brigade was concerned, they had a requirement for 90,



Crab flail development. Most of these are heavy-duty shackles rather than conventional chain, mixed with manufactured links. The ends consist of bob-weights or manufactured links.

yet they were receiving Sherman Crab flails long before the last Scorpion was delivered. By this time the Scorpion was only regarded as a training machine since its limitations had become obvious.

First among these was the rigid mounting of the jib, adopted in the first place only because the hydraulic arrangements on the Baron had proved unreliable. Experience soon showed that on a cross-country course, unless the driver was very careful, the jib was in constant danger of damage from striking the ground when a ditch or bank was encountered. Cooling was not all it might be, but that was par for the course, and now everyone wanted to know why the Valentine Scorpion could not deal with barbed wire.

Late in 1943 and early in 1944 trials were conducted by the Fighting Vehicle Proving Establishment (FVPE) on a Scorpion fitted with wire cutters. These were simply the serrated discs on each end of the rotor, and a new shield device developed by AEC, but not the horizontal cutting bar employed on Baron since everyone now agreed that this did not work. Faced with typical combinations of wire the Scorpion did very well, but when FVPE constructed huge entanglements, the tank was invariably defeated. In the end it was noticed that the lattice girder arms had been twisted out of shape, so the tests were abandoned. Nobody seemed able to agree whether this damage was as a result of the wire trials, or whether the booms had been weakened at some earlier stage, but by now this hardly seems to have mattered since Scorpion III was due to be replaced by an improved version that became known as the Sherman Marquis.

PROTOTYPES PROLIFERATE

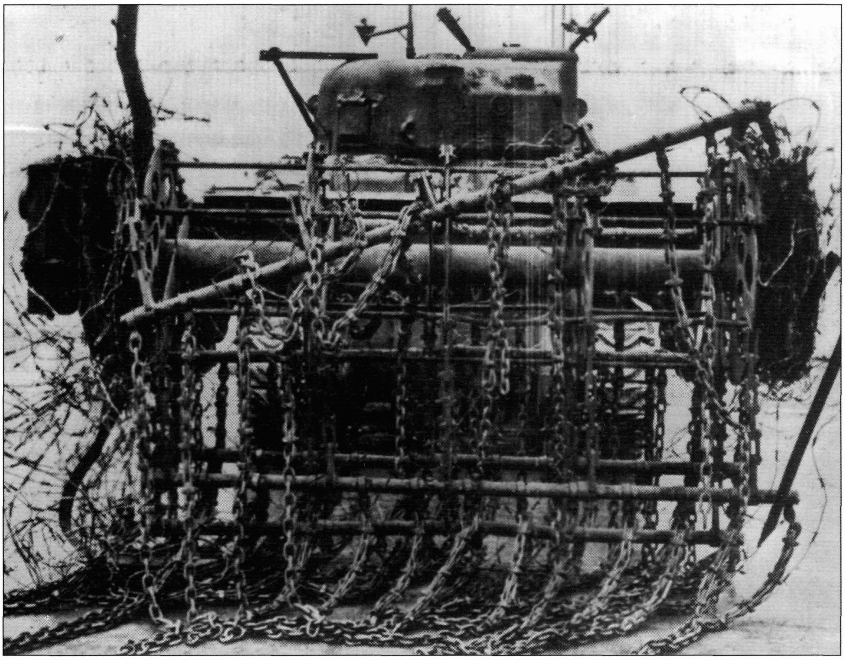
The summer of 1943 was a busy time for flail development in Britain. The matter had become urgent but nobody seemed entirely sure which was the correct system, so many different ones started to appear, some incorporating very outdated ideas. In fact one man was sure. George Rackham, in the midst of all his other work, had concluded, as early as June 1943, that a flail driven directly off a tank's main engine, assuming that engine was powerful enough, was the way to proceed.

About a month later a high-powered meeting was held at the War Office to review the situation with regard to the assault on obstacles. Not everyone was in favour of flails. A representative from the RE said that flails were not the final answer and could never be 100 per cent successful. A staff officer from 21st Army Group did not think that they should be included in the first stages of an amphibious assault, since there would never be sufficient room for everything on the available landing craft. General Hobart took a stronger and characteristically more positive view. He was all in favour of flails, and thought they should 'go the whole hog' and include contouring flail rotors and wire cutters in the package as a matter of course. The meeting agreed, adopted all of Hobart's specifications and went further in stating that, in their collective view, the most suitable tank for flail work had to be the Sherman.

By 1943 the Sherman was the most significant tank in the Western alliance, so in the interest of standardization alone its adaptation to the flail role made sense. Whether the Americans would agree was another matter. They became very sensitive to what they considered British misuse of the tanks that they were stretching every sinew to produce in suitable numbers. On the other hand, the British were slowly learning that it was no use trying to modify old, out-of-date tanks to these support roles. Invariably they were unreliable, too slow and difficult to maintain as spares stocks dwindled. By using the current service tank most of these problems would be eliminated.

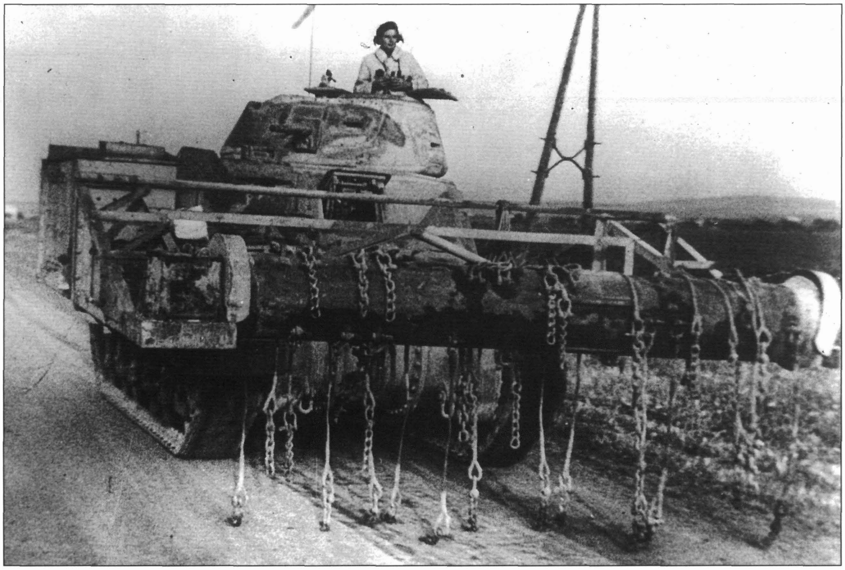
Viewing events with hindsight can be frustrating. To see a gifted character, whom history has judged to be a genius in his field, ignored and overlooked by his contemporaries is very hard to understand. For example, at the meeting held in July 1943 to discuss adapting Scorpion to the Sherman, Rackham rocked the boat by saying that auxiliary engines posed too many problems; he continued to advocate a flail driven off the tank's own engine, a configuration that not only simplified the mechanical arrangements but enabled the tank to retain its firepower.

Rackham's suggestion was brushed aside by the engineer-in-chief who told him that the Scorpion project would be continued, but he was thanked for his endeavours in what read like somewhat patronizing terms. Rackham's response was typical – he would continue with his own project anyway and expected to have a prototype ready by August. One thing that contrasts sharply with this attitude is the story of the Sherman Pram Scorpion, which began in March 1943. As we have seen, Captain du Toit continued to favour the perambulator concept even after it was first rejected, but whether he had any influence on subsequent events is not clear; he is understood to have returned to South Africa in June 1943.



Viewed after an encounter with a wire entanglement, the Sherman Lobster does not look very promising, but it can all be straightened out and, in any case, it was the purpose of the flail to sustain damage if it saved men's lives.

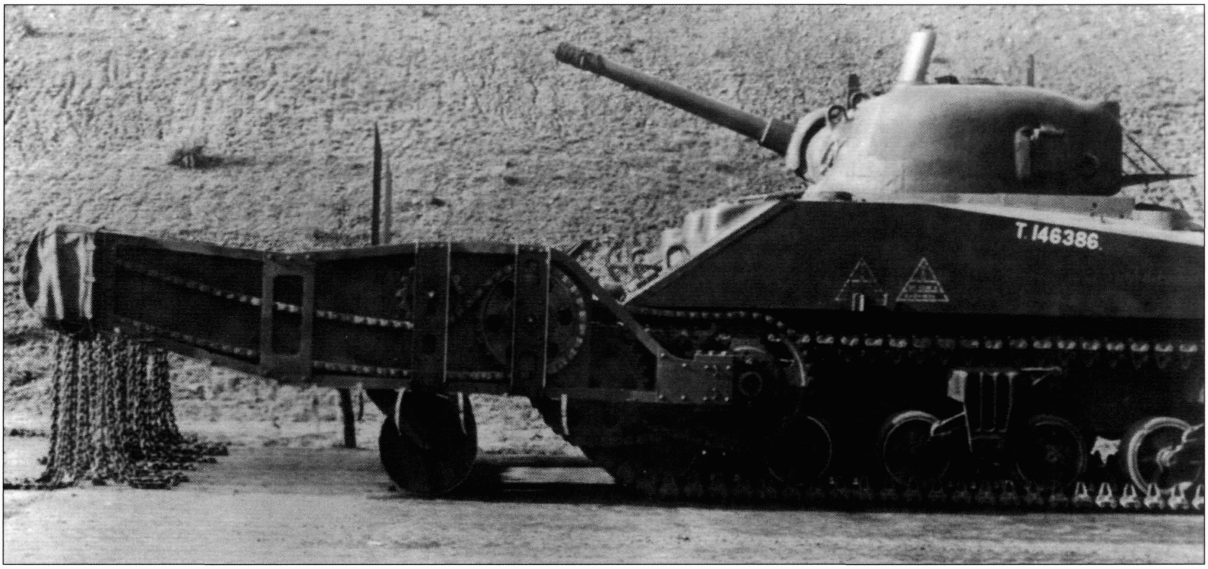
Views of the Grant Scorpion III, turreted or otherwise, are hard to find. Here we see one in Tunisia, taken from an angle that emphasizes the great width and cumbersome nature of the device. It must have been a nightmare to manoeuvre in any kind of restricted space.



The Sherman Pram originated from the Leeds-based engineering company Samuel Butler Ltd, one of a number of firms then engaged on flail projects. Quite why they should be permitted to pursue this as far as the prototype stage is not clear, since it must have looked complicated enough on paper, never mind as hardware. There were advantages: the flail device required very little modification to the tank itself and, of course, the Sherman retained its turret and armament. But these were outweighed by the disadvantages on a grand scale.

One document, printed at the end of the war, refers to it as Crown's Pram, and may well be the only surviving record of the member of the firm's staff who designed it. Drive was taken by a loop of chain, from an extension of each drive sprocket, through a series of secondary sprockets and chains to the drum at the front. The sprockets varied in size since they were required to increase the rotation speed of the drum in relation to the speed that the tank was making over the ground. Although it was attached to the nose of the tank, most of the weight – something over four tons – was supported on two pairs of fairly small rollers that pivoted beneath the arms. These performed reasonably well on a firm surface, allowing for a fair amount of rolling resistance, but they became absolutely hopeless on soft ground so that the entire contraption was immobilized. In order to engage the flail, the tank was obliged to stop and one or more crew members dismount. The task then was to insert pins through the primary sprocket of the flail drive on each side into the drive sprockets of the tank, and the chances are this would not be as simple as its sounds.

Because the rotor was driven from the tracks, and because tracks will move at different speeds when a tank is turning, the actual rotor on the Pram Scorpion was split in the centre. Obviously, steering while flailing was a very dangerous practice but since it might be necessary for the tank to turn before it reached the edge of the minefield, but after the flail drive had been connected, this at least solved that problem so that, while turning, the separate halves of the rotor were flailing at different speeds. Like everything else about this design this all seems to have been more trouble than it was worth.



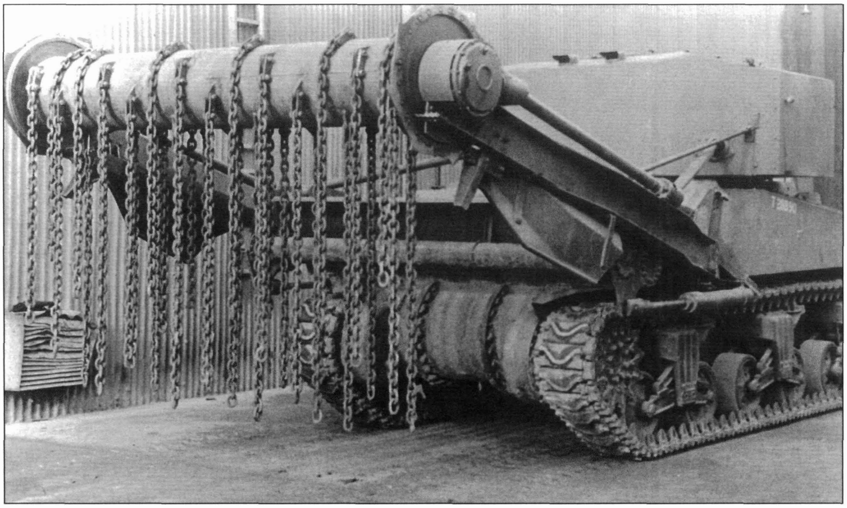
The Sherman Pram Scorpion, showing the cumbersome flail arrangement and the vulnerable system of chains and sprockets required to transfer drive from the tank to the rotor.

The Sherman Marquis, or Octopus as it was originally called, was the official rival to Rackham's Crab. Design work began in July 1943 following comparative trials between the Matilda Baron and Valentine Scorpion, with a view to incorporating the better features of both. It is ironic that even as Rackham was working on his own design, in the shape of the Crab, he was also, as Chief Engineer at AEC, responsible for building both a prototype Octopus/Marquis and a full size wooden mock-up for inspection purposes.

Like most experimental Sherman flails, the Marquis was based upon a Chrysler-powered M4A4 tank, or Sherman V as the British would call it. Like the Scorpion it had a superstructure replacing the turret that housed a crew of two along with a pair of Ford V8 engines, but it had solid flail booms like the Baron yet with the larger-diameter, tubular rotor as seen on the Middle East Scorpions. It also introduced, or rather re-introduced, a hydraulic system to raise or lower the booms.

It is worth recording that this system was one of the most heavily criticized features of the Matilda Baron because it was always going wrong. At the same time, however, the fixed lattice arms of the Valentine Scorpion were not popular because they could not be raised and consequently suffered damage on uneven ground. Yet like the Valentine the Marquis had a pair of drive shafts, one from each engine, running more or less parallel to each arm and driving the rotor from both ends. And again it should be emphasized that the facility to raise and lower the boom was not to permit contour following by the flail operator, but in order to keep the boom up high while driving and to reduce storage space, particularly on landing craft. Reports say that using hydraulics alone the boom would hold up for about 15 minutes, but for longer periods a locking device was incorporated.

Another failed development was the Sherman Lobster, although it came after the successful development and use of the Crab. Early trials of the Crab were disappointing, as we shall see, largely due to damage inflicted on the rotor and chains by exploding mines. Since, at that stage, the true reasons for this effect were not properly understood, it was



The turret on the Sherman Marquis flail looks enormous in this picture. Notice how much the drive shafts have to move when the rotor is raised, and the hydraulic system used to effect this.

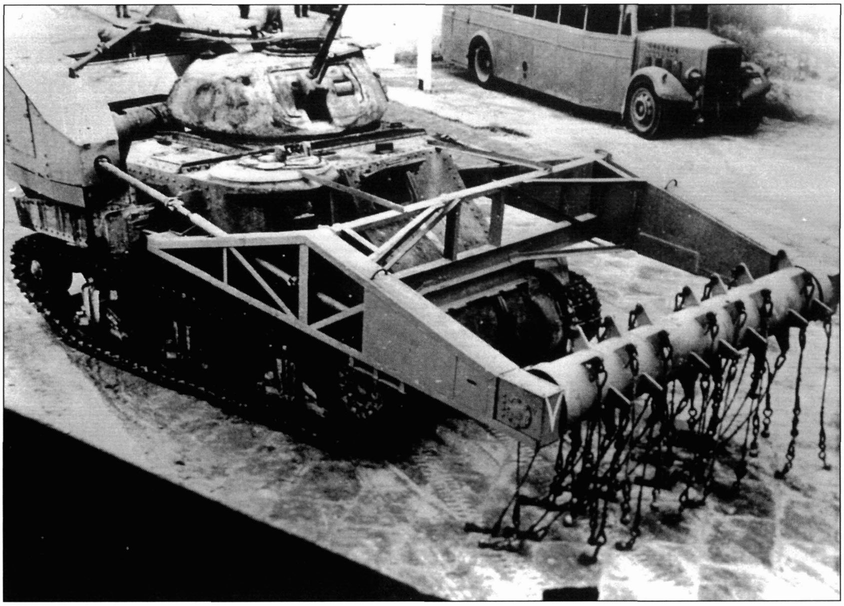
hoped that a skeletal rotor would be better and that, in effect, is what the Lobster was: a Crab with a Baron-type rotor. AEC assembled it, using the original Crab prototype T150483 as the basis, in February 1944. Had it been successful, the scheme was to introduce it once the Crabs already ordered had been completed. As it was, there was no need. In terms of mines detonated it was slightly inferior to the Crab, but when it came to dealing with barbed-wire entanglements it was a lot worse. The stuff wound itself around the rotor and brought the entire thing to a halt. It was also somewhat heavier than the Crab and not so easy to stow. Even so, the prototype was retained and used for various experiments, among them a method to make the rotor follow the contours of the ground.

THE SCORPIONS SPREAD

Following their limited success at Alamein, the surviving Scorpions, plus those that had missed the battle, were passed on to 41st RTR, which was destined to become the one and only flail regiment in North Africa through to the end of the campaign on 13 May 1943. The existing tanks were steadily returned to workshops and a few new ones added until the regiment had 24 of the improved Scorpion Mark IIs, sufficient to equip A and B Squadrons.

Meanwhile, in recognition of 41st RTR's singular role, application was made to the War Office for the regiment to be renamed 1st Scorpion Regiment Royal Armoured Corps. This took time, so for a while it was known as T (for Temporary?) Scorpion Regiment RAC. In fact, it was May before the change became official and the regiment was issued with a cloth shoulder badge showing a red Scorpion, which looked more like a lobster, on a yellow rectangle which was worn on the left shoulder.

An official organization chart was also delineated in which each of the three squadrons had the following equipment: a Squadron HQ consisting of one armoured car or scout car and two Valentine pilot tanks with four troops, each of three Scorpions. The pilot tanks were fitted with anti-mine rollers and used to locate rather than clear minefields. Later on they were also equipped with the Centipede towed roller device.

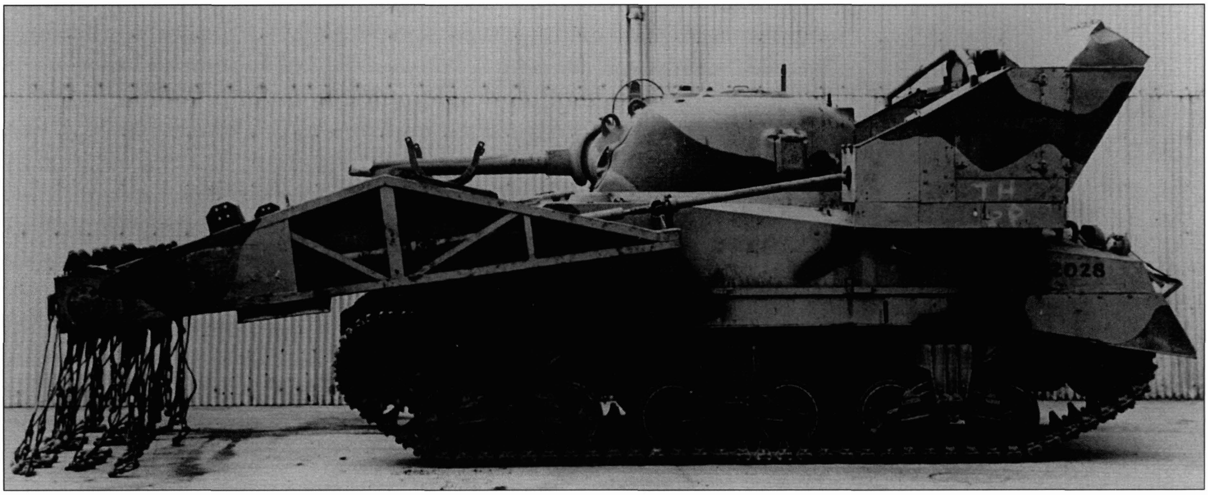


Back in Egypt by mid-1943 the workshops had now come up with a twin-engine version of the Scorpion powerful enough to spin more chains. An experimental prototype was mounted on a Grant II. Petrol for the flail engines was stored in a tank that can just be seen on the rear deck. The Grant II had a diesel engine.

There is no space here to cover the various actions that the Scorpion Regiment engaged in with both Eighth and First Armies in the weeks leading up to the German capitulation in North Africa, but one aspect cannot be ignored, as it was typical of the British Army. Here we had a new device, probably as valuable in its own right as any weapon. Yet it had been created on a shoe-string budget with little official encouragement and kept going by the enthusiasm and dedication of its personnel for the benefit of all. It had started off with lame tanks that nobody else needed and these were now almost completely worn out. The War Diary records more mechanical failures than successes in most of the later battles, particularly as more barbed wire was encountered, which wrapped itself around the flail rotor and effectively choked the tank's flail engine. Help was on the way, but it was still of the 'make do and mend' variety.

Efforts to find a suitable replacement began early in 1943 and eventually settled upon the American M3 Medium tank in its British guise as

The same twin-drive arrangement as the experimental Grant II Scorpion was mounted on a Sherman V (M4A4) and four or five were built. One was sent to Britain for comparison with a Crab, while the remainder saw limited use in Italy.

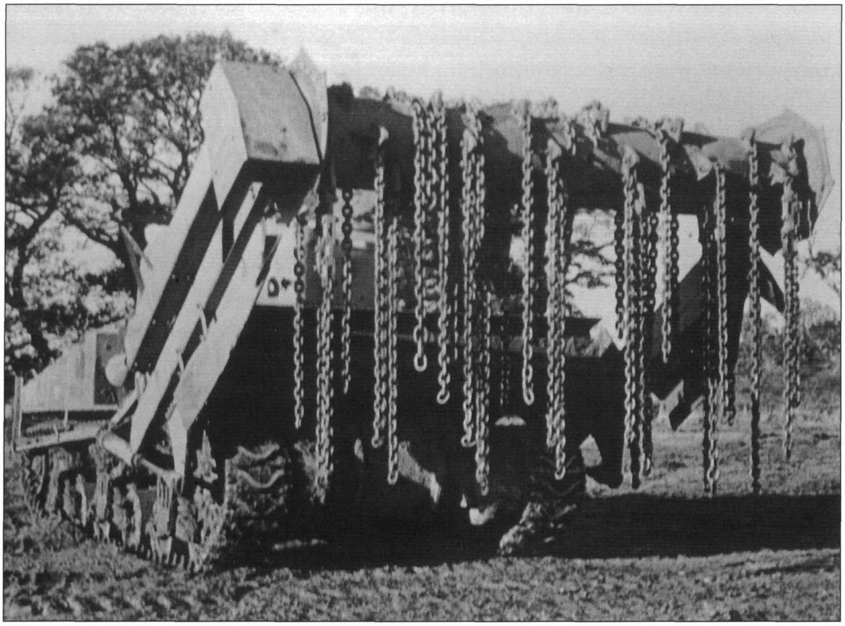


the Grant. Back in Alexandria, No.7 Base Ordnance Workshops began a programme which, it was hoped, would provide sufficient Scorpions to equip all three squadrons of the regiment, plus 100 per cent replacement, or near enough. The total order was for 70.

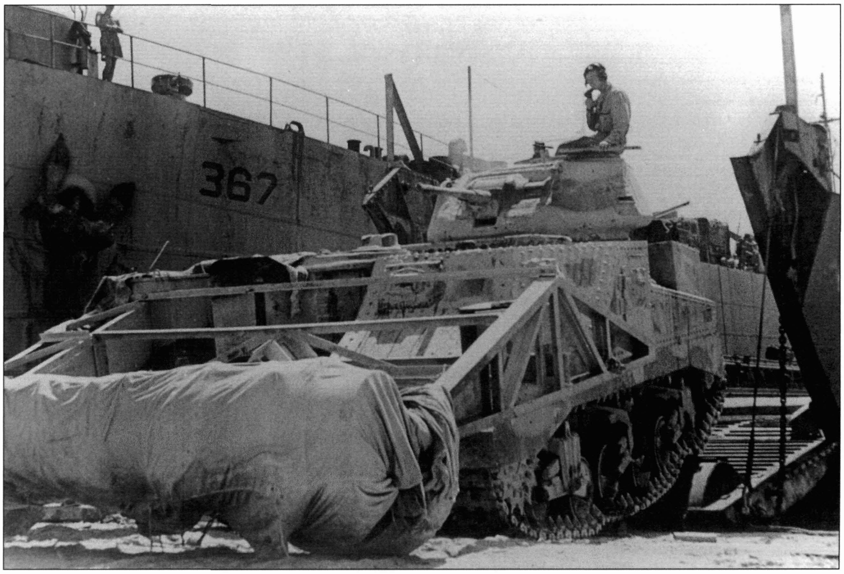
The Grant was a wise choice, given that there was not a lot to choose from anyway. It was reliable and fast enough to move from place to place a lot quicker than a Matilda, but more important was that it was available, as it was replaced in combat regiments by the Sherman. In order to fit the flail apparatus, which was essentially the Scorpion II arrangement from the Matilda, it was necessary to remove the Grant's greatest asset, its hull-mounted 75mm gun. However, the vacated space turned out to be an ideal location for the flail operator.

Less sensible was the removal of the tank's turret, with its 37mm gun and co-axial Browning. Presumably this was done in line with the previous practice of disarming the Scorpion II, although in this case it was not necessary. Indeed it tended to be more dangerous for, when the first of these tanks were issued to the newly recreated C Squadron, there was quite a large hole in the top where the turret had been, and crews did not like this. This new equipment was designated Scorpion III.

C Squadron received 11 Grant Scorpions on 17 March 1943, eight of which were earmarked for action at Wadi Akarit on 6 April 1943. Temporary measures were taken to provide at least some protection to the top, but in the event the Grants were not used. Some 12 days later, six 37mm turrets turned up and were duly fitted. No doubt much to the dismay of C Squadron, four of these were then handed over to A Squadron to supplement their dwindling stock of Matildas, and they used them at Takroum on 21/22 April in support of the 2nd New Zealand Division. It was not an auspicious start. Mechanically, the Grant Scorpions did all that was required of them and the crews liked the turret and the taller hull, which gave them a better view. Where they came unstuck was due to the effect of detonating mines and rough ground, which caused the flail drive



An early production Crab I with the arms raised. The flails are made from ordinary chain with no weights at the bottom. An armoured box covers the place where the drive emerges from inside the hull. This is said to be the first photograph of a flail tank released for publication.



The Grant Scorpion IV does not look that different from the Scorpion III at first glance, although from this side the more robust rotor support arm is obvious. The photo was taken in Tripoli, during practice for the forthcoming Sicilian landings.

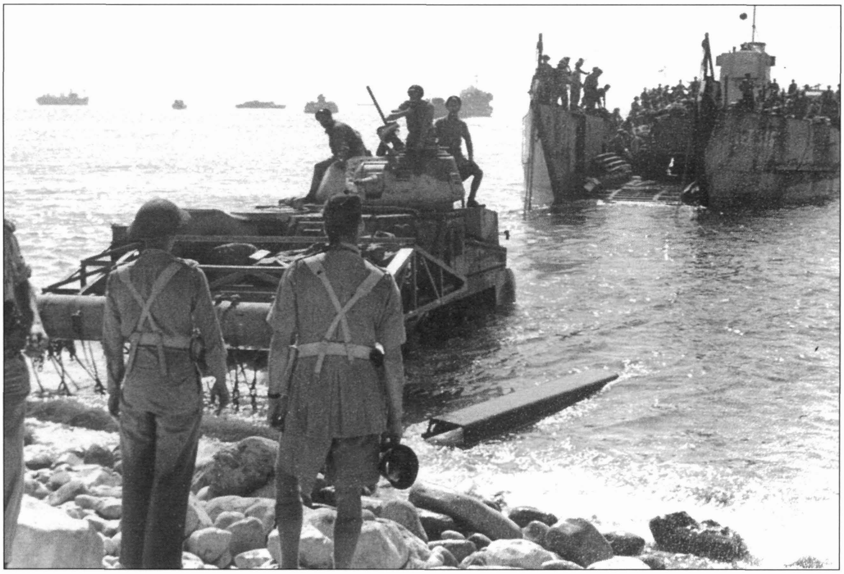
shafts to buckle and rotors to split. This malfunction was put down to the fact that the arms supporting the rotor did not have enough give in them and reacted badly to violent shocks. The Takroum action was the only occasion that records show the Scorpion III being used in combat, so it seems that production was probably curtailed.

Even if the first Grant Scorpion had worked properly, its useful days would have been numbered since, at 13ft 8in. (4.2m) wide, it was just too wide to pass through the bow doors of existing landing craft. Apart from a bit of clearing up there was not a great deal to do in North Africa any more. Yet flails would still be required, so it was decided to improve the design and it emerged, in May 1943, as the Scorpion IV. Outwardly the most obvious change, which serves to identify the new model, is a redesign of the gantry arms. Instead of an arrangement of two sets of girders, spaced slightly apart, the Scorpion IV had a single set made from much stronger members. Indeed, although it is not so obvious a number of components were strengthened, including the rotor itself. This effectively reduced the width; it would still be a tight fit, but if the tank was lined up correctly on the landing craft and driven with care it was possible to pass through the gap with about 5in. (12.7cm) to spare on each side.

Production appears to have moved closer to the scene of action, since C Squadron recorded receiving 12 of them from No.3 Army Base Workshops in Tripoli in June. Thirty more were made available for the other two squadrons at about the same time, but no source is given. Most of these would have been Scorpion IIIs modified in production, plus a few new machines and ultimately the original group handed in for conversion. With Operation *Husky*, the landings in Sicily, no more than a month away, trials were also conducted at Tripoli with landing craft.

At around this time it was decided to expand flail operations in the Mediterranean theatre with the creation of two more units, which ultimately became 400th and 401st Independent Scorpion Squadrons, equipped with a dozen Scorpion Mark IVs along with two Valentine pilot tanks each. The 401st was shipped out to the Far East in October 1943, while the 400th was stripped of its tanks and the personnel shipped

Another Grant Scorpion IV, now with the flail rotor uncovered and a Browning machine gun mounted on the turret, lands from an LCT (4). This is How Beach, near Avola, on 10 July 1943.



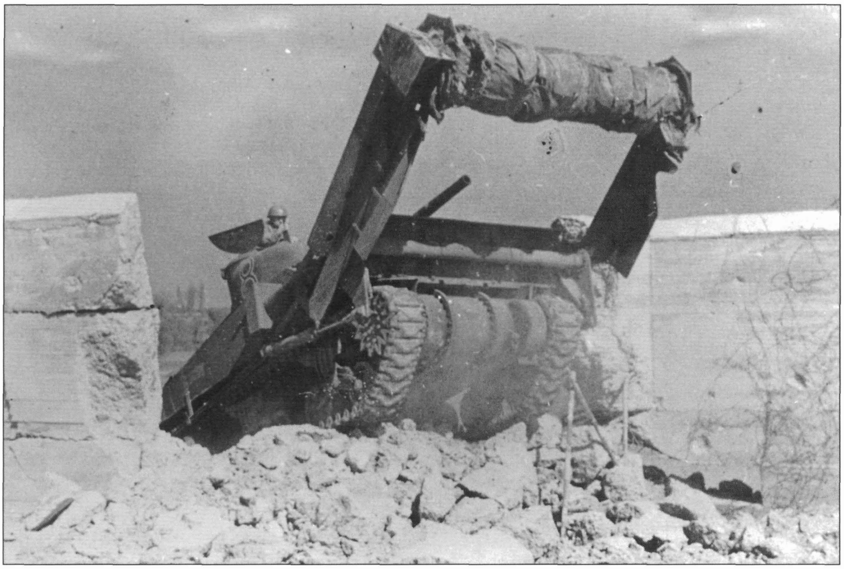
back to the UK where, according to legend, they joined 30th Armoured Brigade, which was to operate flails in 79th Armoured Division.

Operation *Husky*, the Allied assault landing in Sicily, began on 10 July 1943 and B Squadron, which at the time had a full complement of 15 Scorpions, came ashore with 50th Division, mostly in the Acid North sector on the east coast. The geology of the island did not really lend itself to the creation of large minefields; the rocky terrain was sufficiently difficult to deal with, so the squadron was employed mainly behind the lines, clearing secondary routes. They were joined by C Squadron about a month later.

Experience on Sicily emphasized something that was already suspected and threw up another problem. The new difficulty concerned the RE's latest and most marvellous tool, the Bailey Bridge. It was not quite wide enough to cope with a Scorpion IV. However, those concerned with flail development had already concluded that the existing Scorpion system was not strong enough to deal with a new generation of German mines.

During their time in Egypt the two independent squadrons had assisted in a number of trials. Most of these trials had to do with the design of the flail itself, and was largely empirical, trial-and-error work, but the most important development was a matter of common sense. It became clear that in order to make a better job of clearing a given area of mines it would help if more flails could be added to each tank's rotor, but there was not sufficient power in the existing engine to achieve this. The solution was to use two engines to drive each flail; this configuration would not only handle more flails, but probably also hit the mines harder.

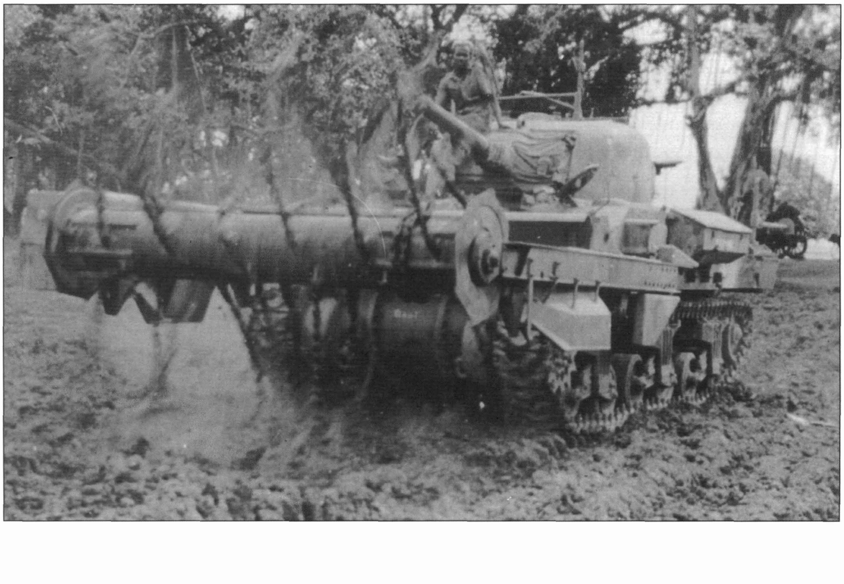
Under the existing system two engines meant greater width, so the designers came up with a new idea, first tested upon a turreted Grant. The original experiments appear to have involved Ford V8 power units, but ultimately Dodge engines were employed. To reduce width, these were located more or less above and behind the tank's turret, which effectively reduced its ability to traverse, and then drove forwards by means of long, universally jointed shafts, to each end of the rotor. Despite the fact that there seems to have been a shortage of new German



Training for the assault, a Crab with its chains securely wrapped in canvas tackles a breach in a training wall. At this point the driver is unable to see anything worthwhile and relies on the commander to guide him.

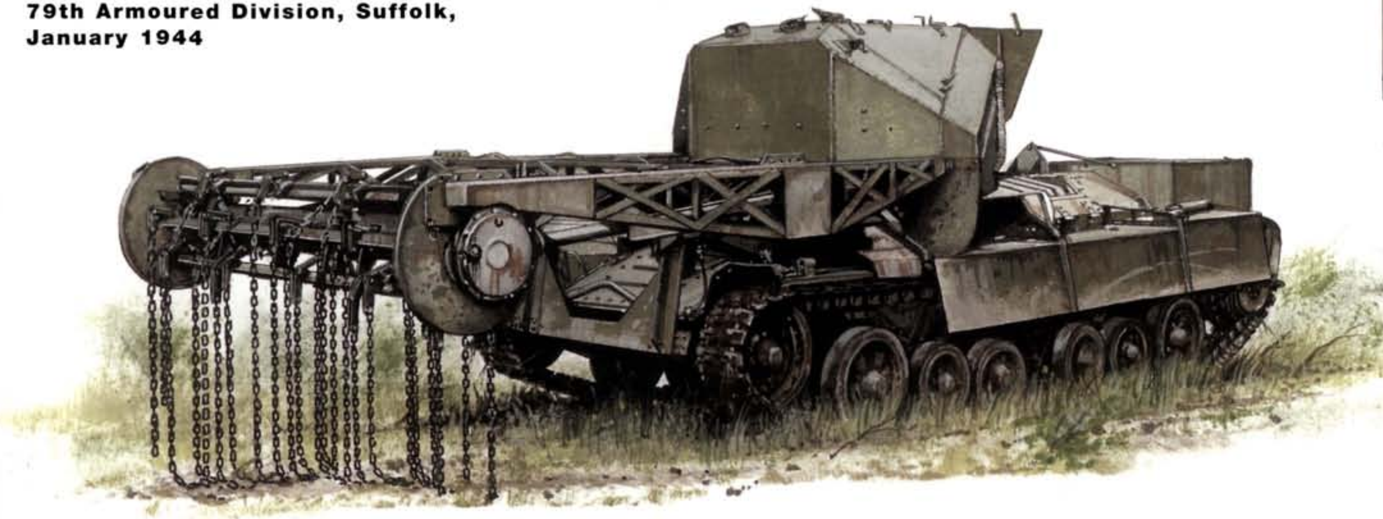
mines to test it against, the new twin arrangement was clearly approved and authority given for No.7 Base Ordnance Workshops to convert 24 Sherman tanks to this role. These were designated Sherman Scorpion Mark V (Twin) and later Scorpion Mark V* when the latest type of flails were fitted.

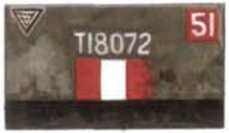
Wire had started to become a menace during the latter stages of the campaign in North Africa, but no attempt seems to have been made to fit cutters, as had occurred in the United Kingdom. Instead, crews had started to use an explosive charge contained within a metal tube, carried on the tank, which were detonated in the wire to break it up before the tank attacked it. Later developments enabled the crew to launch and detonate these tubes without leaving the tank and with the Scorpion V this equipment became a standard fitting. Another refinement, albeit not one to be used when action was imminent, was that the entire gantry assembly could be dismantled and stowed on the tank for transport purposes.

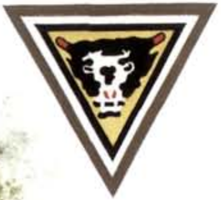


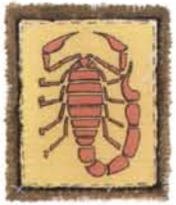
A Crab II in India beating across hard, dry ground. The strips of metal welded to the ends of the rotor were intended to make it easier to remove wire when it became wrapped around the drum.

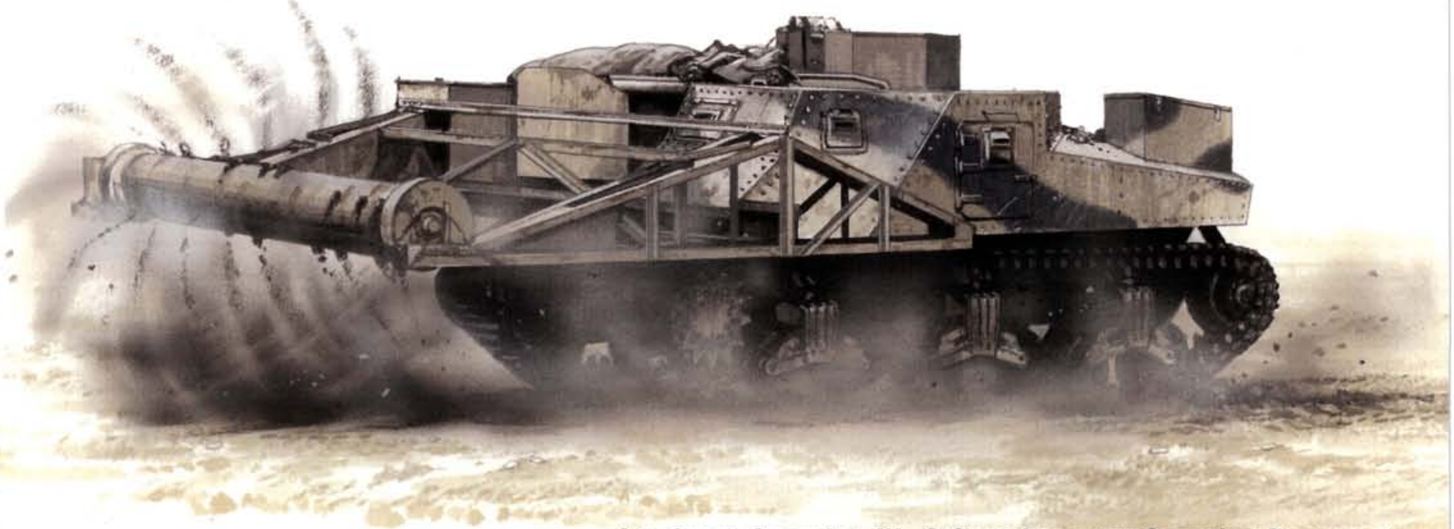
A1: Valentine Scorpion III, 22nd Dragoons, 79th Armoured Division, Suffolk, January 1944

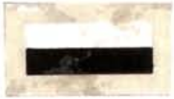






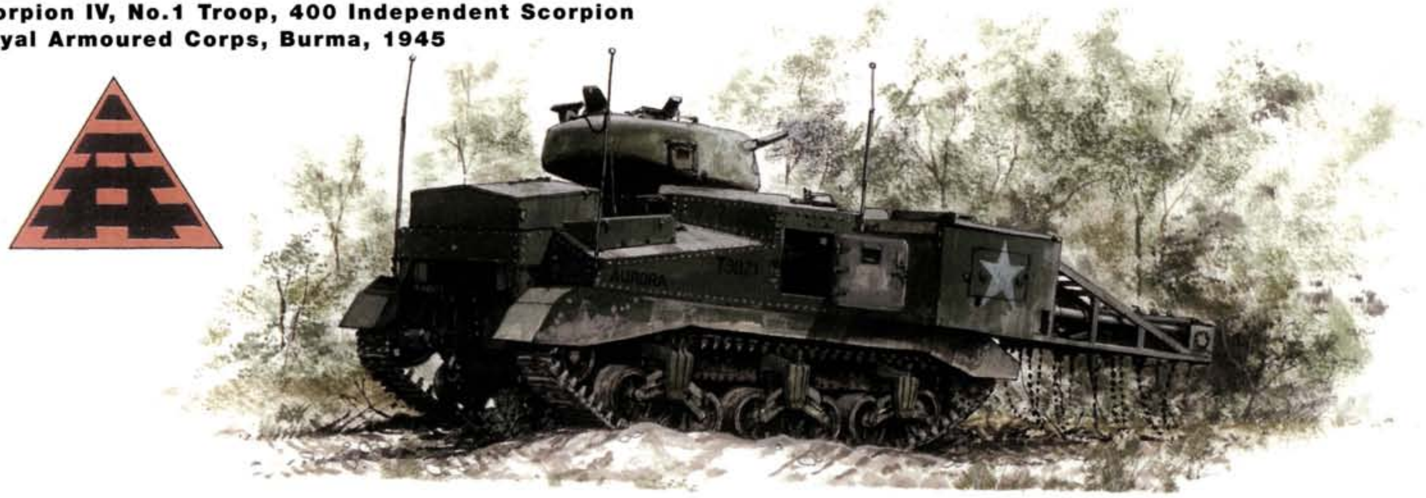




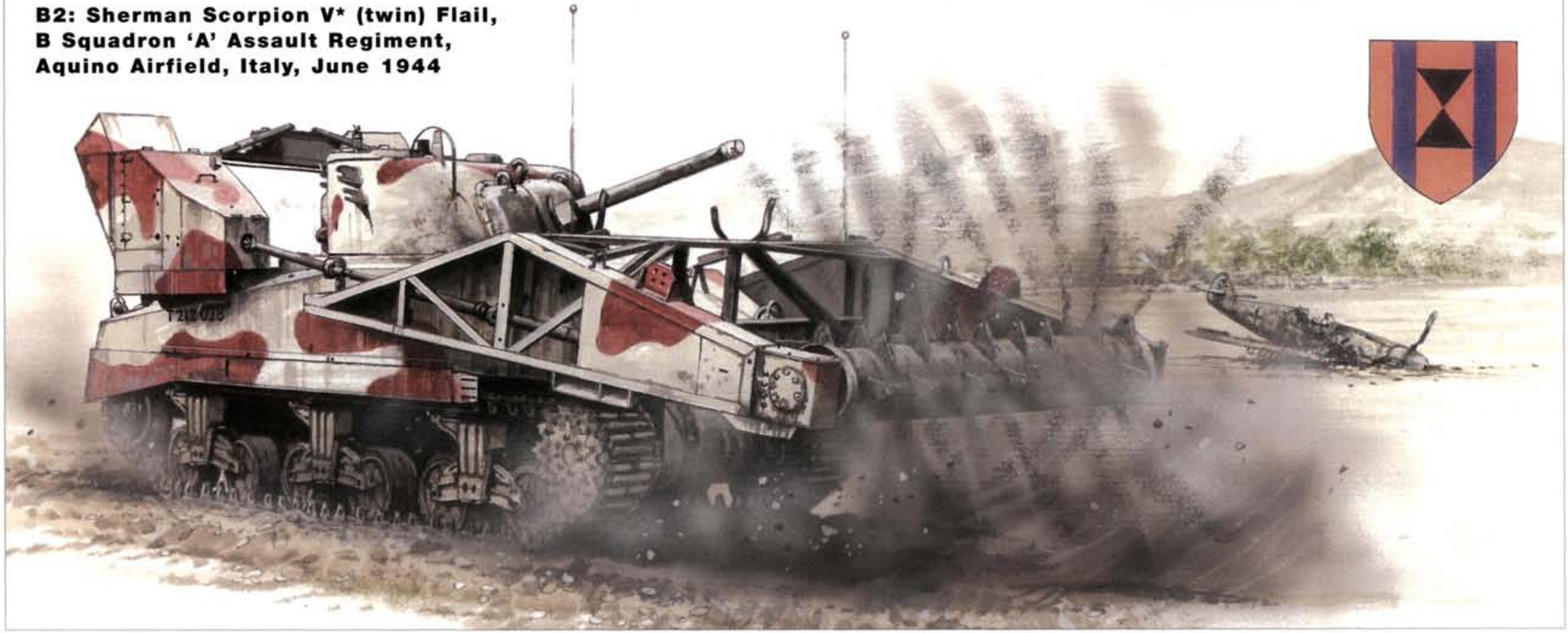


A2: Grant Scorpion III, C Squadron, 1st Scorpion Regiment, Royal Armoured Corps, Tunisia, April 1943

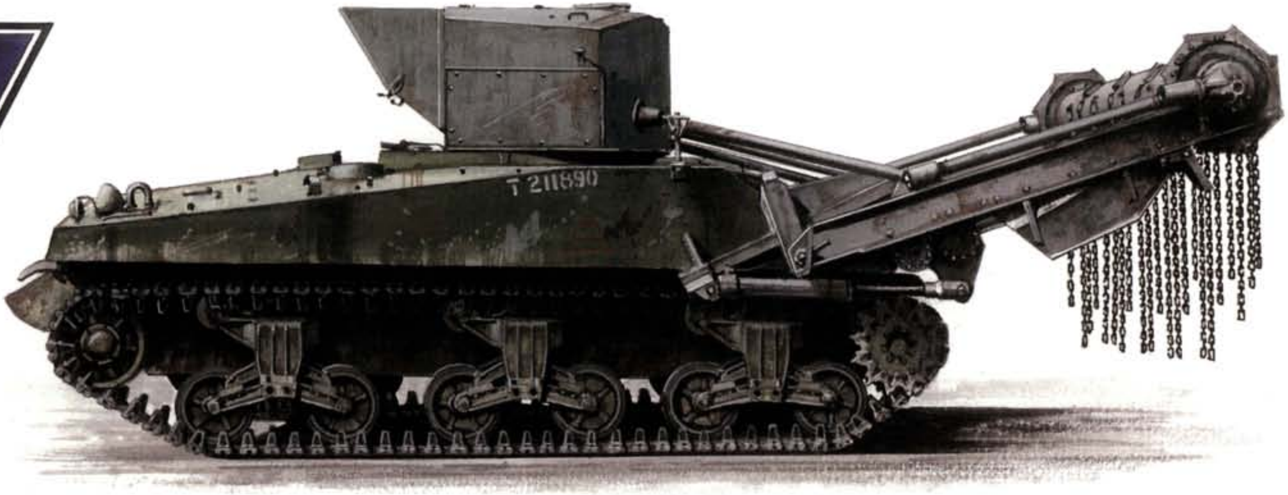
B1: Grant Scorpion IV, No.1 Troop, 400 Independent Scorpion Squadron, Royal Armoured Corps, Burma, 1945



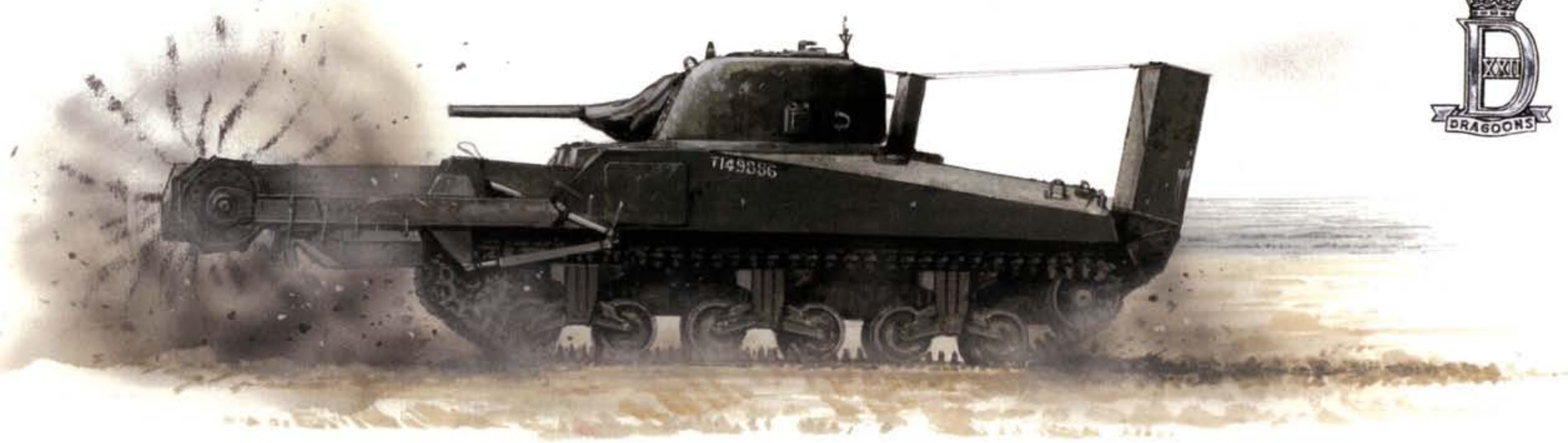
B2: Sherman Scorpion V* (twin) Flail, B Squadron 'A' Assault Regiment, Aquino Airfield, Italy, June 1944



C1: Sherman Marquis Flail Tank, AEC Ltd, Southall, October 1943



C2: Sherman V Crab I, 22nd Dragoons, 30th Armoured Brigade, Normandy, 6 June 1944



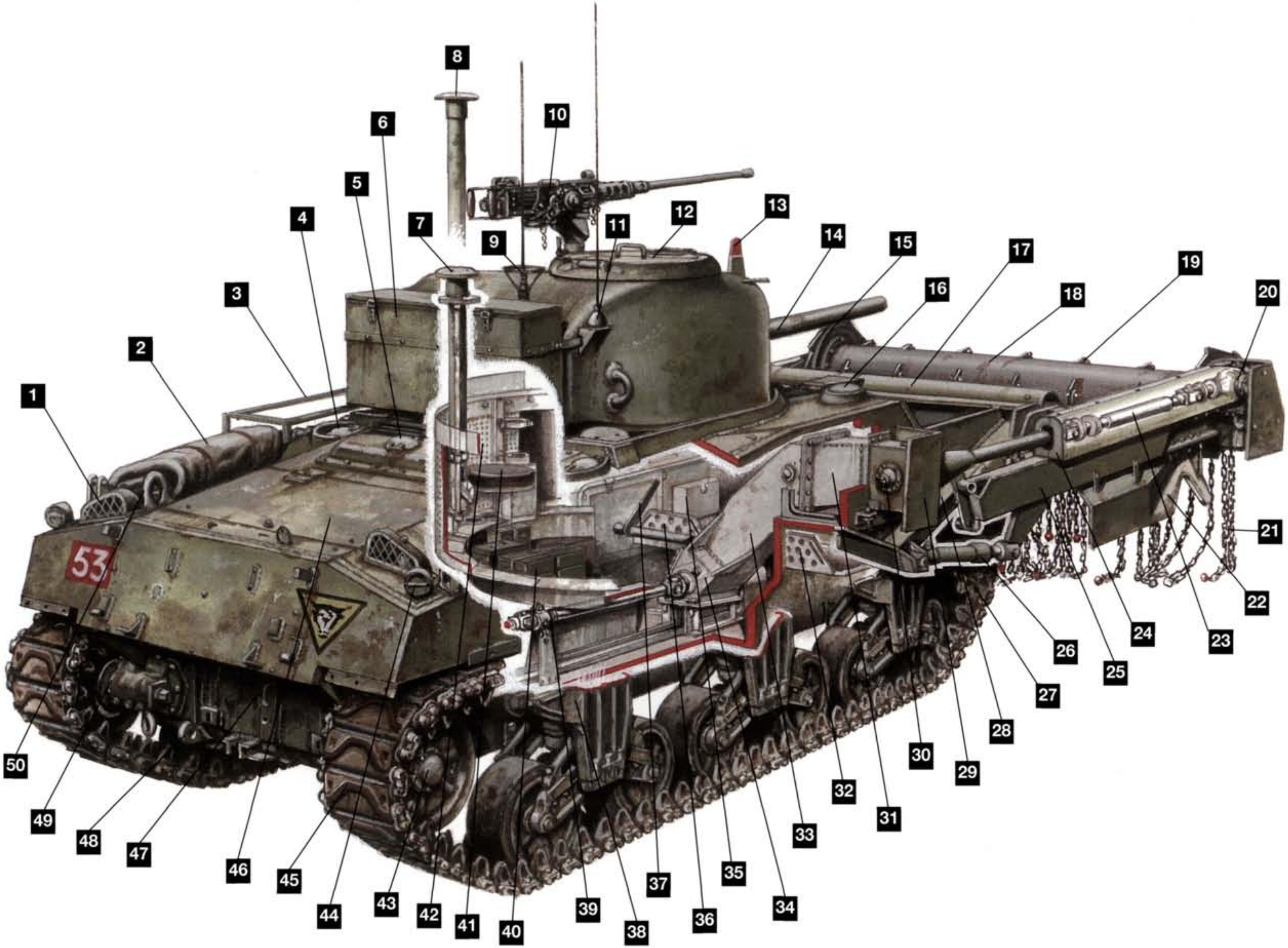
D: SHERMAN V CRAB I, WESTMINSTER DRAGOONS, 30TH ARMOURED BRIGADE, 79TH ARMOURED DIVISION, 1944

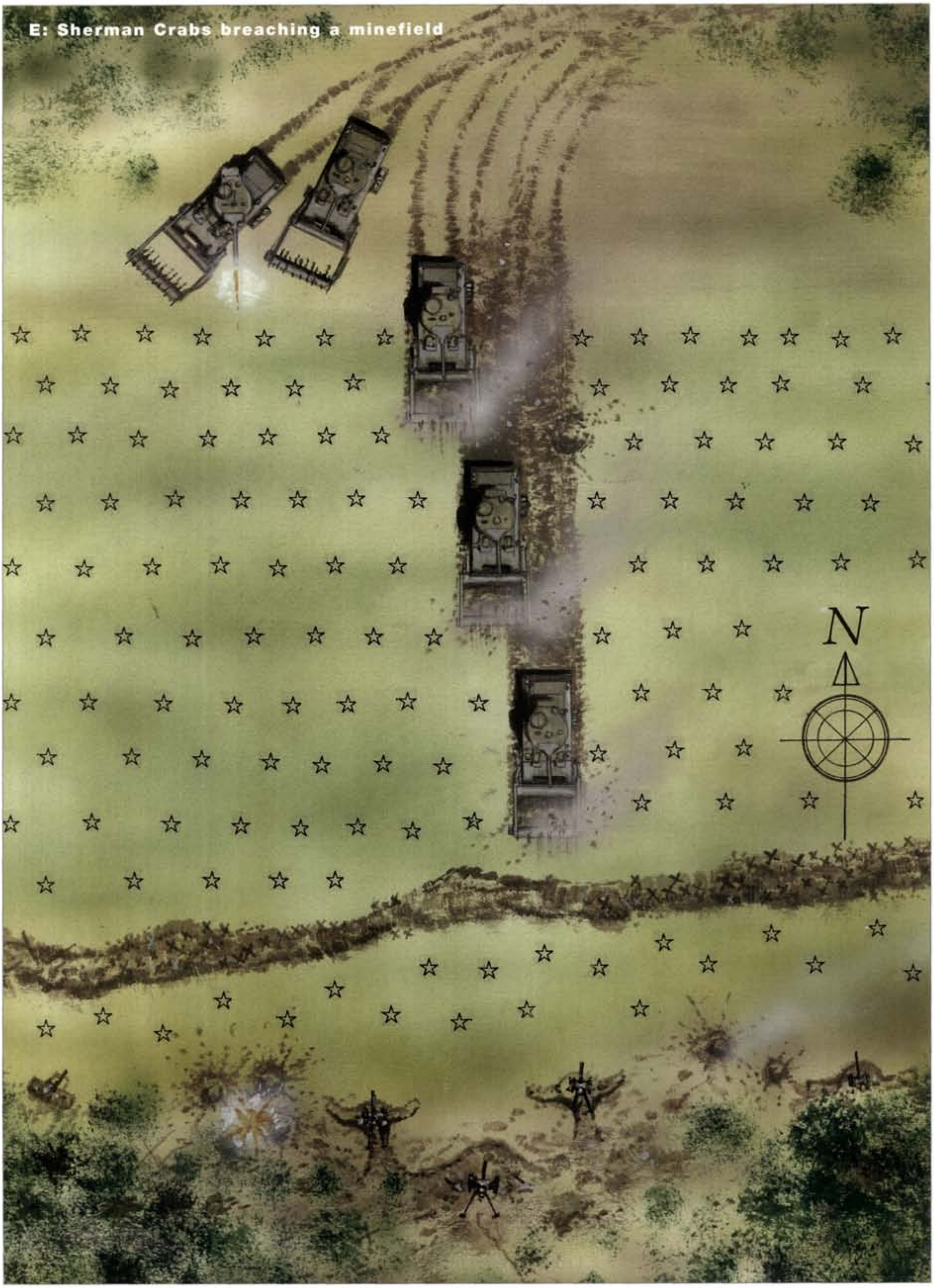
KEY

1 Air inlet
2 Tarpaulin cover
3 Spare chain holder
4 Left fuel tank filler
5 Radiator filler
6 Turret stowage box
7 Binnacle compass projector retracted
8 Binnacle compass projector extended
9 'B' aerial base
10 M2 Browning .50-cal. machine-gun
11 'A' aerial base
12 Commander's hatch
13 Vane sight
14 M3 75mm gun
15 Side rotary wire cutter
16 Ventilator
17 Flail jib cross-member and shield
18 Flail rotor drum
19 Flail chain attachment point
20 Flail drive bevel gearbox
21 Flail chain
22 Wire deflector
23 Flail drive shaft
24 Flail drive shaft cover
25 Right side flail boom
26 Jib elevating piston
27 Drive sprocket
28 Right side flail boom support bracket
29 Armoured cover for rear flail drive gearbox
30 Rear flail drive gearbox
31 Flail chain drive upper case
32 Co-driver's seat
33 Flail chain drive lower case
34 Flail drive power take-off
35 75mm gun cover locker
36 Driver's seat
37 Flail activating lever
38 Suspension unit
39 Main drive shaft
40 Machine-gun ammunition stowage
41 Loader's seat
42 Turret basket
43 Track idler wheel
44 Tail light
45 Steel chevron track
46 Engine deck hatch
47 Engine access doors
48 Towing lug
49 Idler wheel mounting bracket
50 Lifting ring

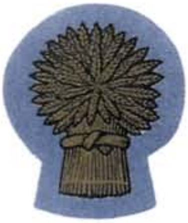
SPECIFICATIONS

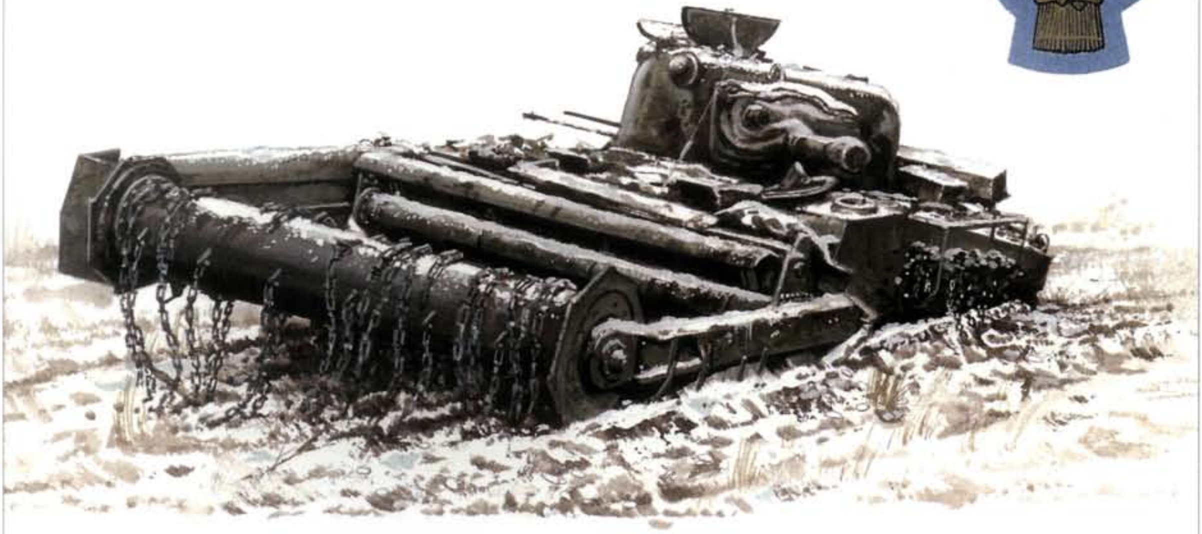
Crew: 5
Combat weight: 34 tons
Overall length: 27ft 8½in. (8.4m)
Width: 11ft 11½in. (3.6m)
Height: 9ft 10in. (3m)
Engine: Chrysler A57 multi-bank
Transmission: Five-speed syncromesh and controlled differential steering
Fuel capacity: 160 gallons
Fording depth (unprepared): 42in. (1.7m)
Armament: M3 75mm, 2 x M1919 Browning .30-cal., M2 Browning .50-cal. machine-guns
Ammunition stowage: 74 rounds of 75mm, 17 boxes of .30-cal. and 5 boxes of .50-cal.
Muzzle velocity: 2,030ft (619m) per second
Effective range: 3,500 yards (3,200m)
Gun elevation/depression: +25/-10 degrees
Speed: 20mph (32km/h)
Flailing speed: 1.5mph (2.4km/h)


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
53

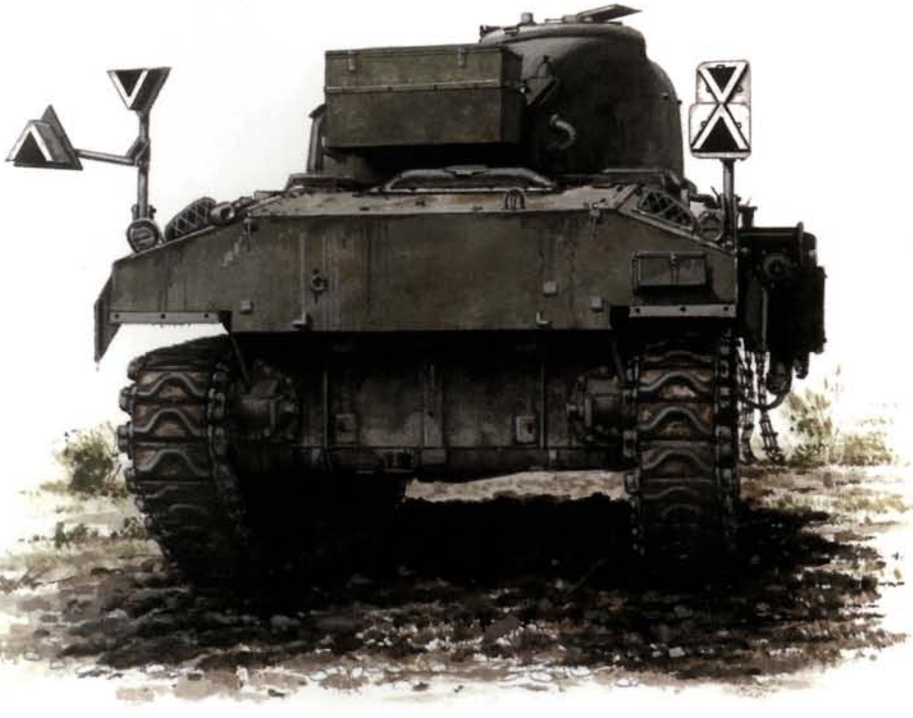

E: Sherman Crabs breaching a minefield

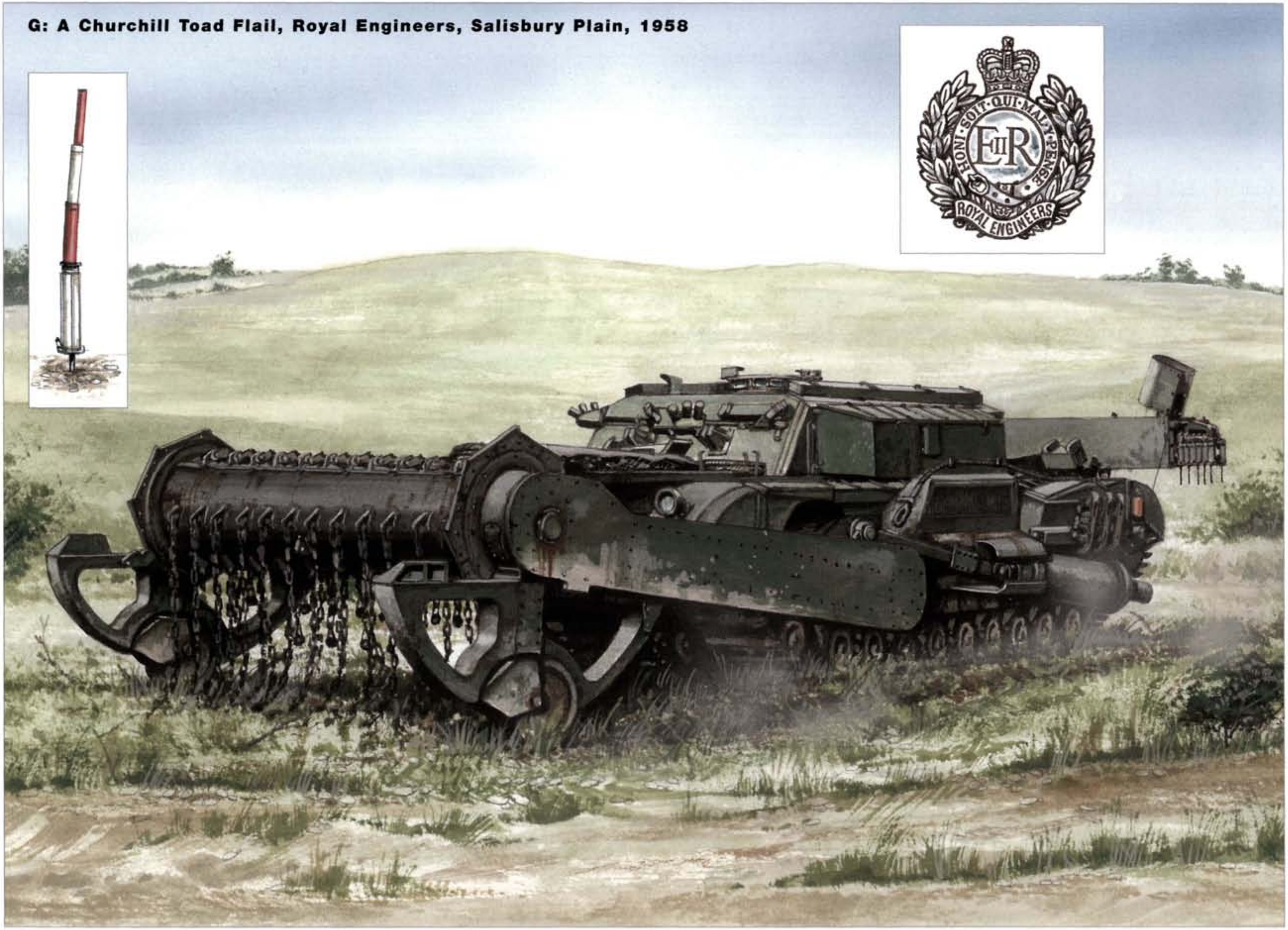
F1: A Sherman V Crab I, 1st Lothian & Border Horse, 30th Armoured Brigade, Winter 1944–45





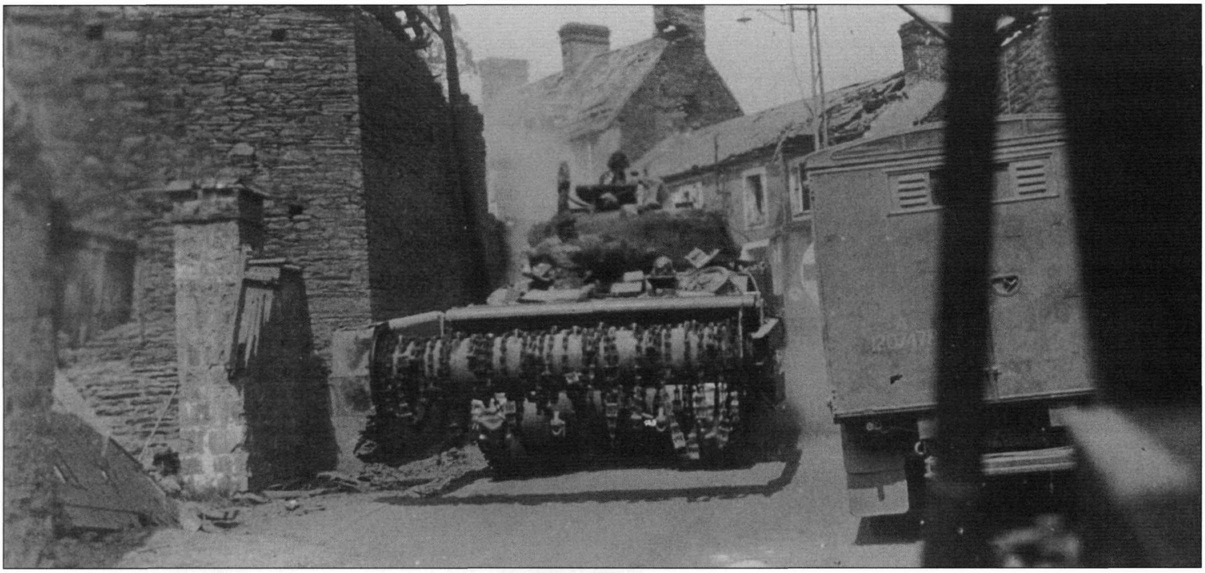
F2: A Sherman V Crab II with station-keeping equipment, Britain, 1945





G: A Churchill Toad Flail, Royal Engineers, Salisbury Plain, 1958

HONI SOIT QUI MAL Y PENSE
EIIR
ROYAL ENGINEERS



A snapshot, said to have been taken in Villers-Bretonneux, shows a Crab with camouflage netting around the turret, and the flail chains wound around the rotor, passing an ambulance convoy in a narrow street.

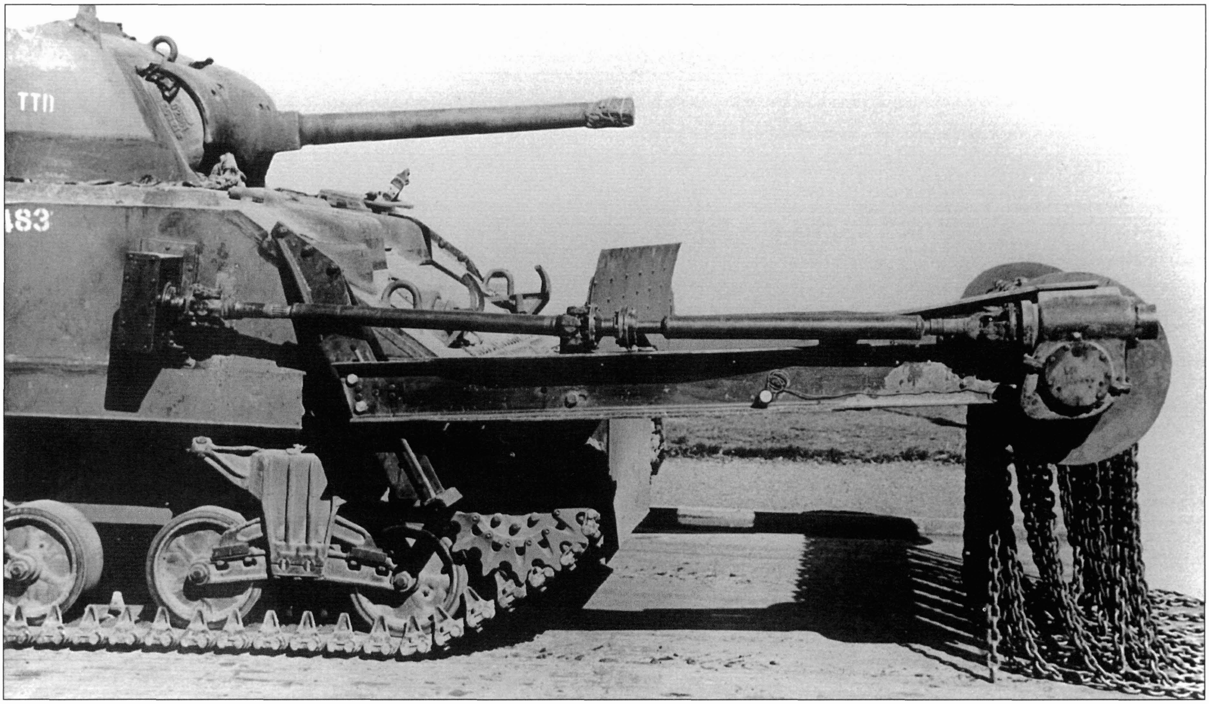
Generally speaking, it has to be said that away from the wide expanse of the desert the Scorpion system failed to work as well as might be hoped. It clearly did not suit European conditions, but there was also a serious failure in the quality of materials used to make the actual flails. Even so, one example of the Sherman Scorpion V equipment was shipped to Britain where it was compared with a Sherman Crab and judged by the experts to be almost as good.

THE CRABS MOVE IN

By August 1943 a prototype Crab was ready for examination at Southall, based on a Sherman V (M4A4) and subjected to initial trials the following month. Compared with the fully developed model it was very basic. The arms that supported the rotor looked particularly flimsy, and did not include hydraulic equipment. There were no wire cutters at the ends of the rotor drum. The mechanical arrangements were extremely simple compared with what had gone before and were very much on display.

Inside the tank a sprocket was driven from the propeller shaft between the engine and transmission. From here drive passed via another sprocket and two loops of roller chain, to a third sprocket outside the armour on the right side. This meant that a hole had to be cut in the tank's side armour, but in order to protect the crew, this chain drive was enclosed in a light metal casing. Outside the hull the final sprocket was fitted to the end of a Cardan shaft, which carried the drive forward along the right arm to a spiral bevel gear, which in turn rotated the flail drum.

For the first time (except in the case of the Pram Scorpion) no separate engine was required to drive the flail. In action the driver would engage the flail with the tank in first gear only and then move forward. What Rackham had recognized, but everyone else seems to have ignored, was that since tanks only flailed at very low speeds a lot of potential power from the tank's own engine was going to waste. Under normal circumstances the Chrysler-powered M4A4 in first gear, at 2,000rpm with the flail engaged,



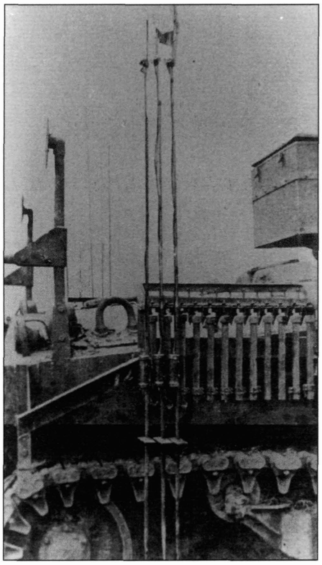
moved forward at 1.62mph (2.6km/h) while the rotor turned and flailed at 180rpm. Since this did not change when the tank started flailing uphill, it was clear that there was power to spare.

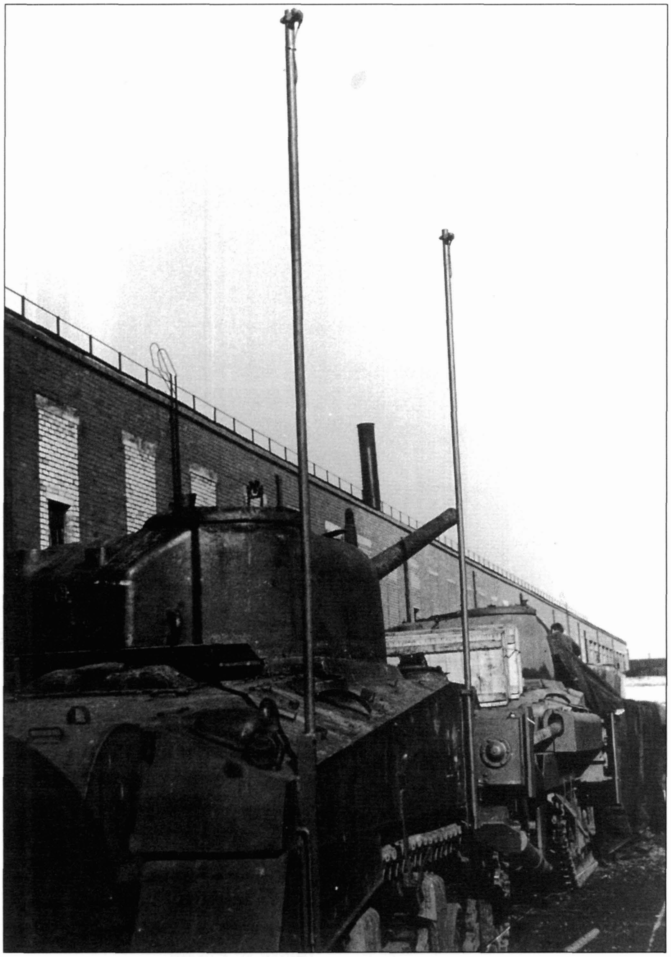
However, the real key to the success of the Crab was the way that the flail chains were attached to the rotor drum. Hitherto the trend had been to attach rows of chains to the drum, and these chains struck the ground in succession. In Rackham's design, if one looks at it closely, it can be seen that the attachment points are arranged as a series of parallel spirals so that the chains thrash the ground much more evenly than before.

A production prototype Crab was tested a month later in October 1943 and there is some evidence to suggest that it was on an M4 (Sherman I) tank. The original plan was to produce a number of Crab and Marquis flails for competitive trials, but the superiority of the Crab was recognized at once so this scheme was dropped. The production prototype not only featured stronger support arms for the rotor, these in turn were now controlled by the same hydraulic system that had been developed for the Marquis. During the trials a number of recommendations were made which would be incorporated into the production machines. Externally these included the provision of armoured covers to protect the flail drive mechanism and, inside, a selection of navigational aids, including gyro and projector binnacle compasses and a distance indicator calibrated in yards.

As soon as these trials were completed, an initial order for 330 Crabs was placed, to be ready by March 1944. The work was to be shared by Curran Brothers in Cardiff, Milner's Safe Company in Manchester, T. C. Jones & Co. in London and J. Hibberts Ltd of Darwin in Lancashire. So, in terms of design, all of the eggs were in one basket and as if on cue, a serious fault suddenly put in an unwelcome appearance. Further comparative

ABOVE **Rackham's prototype Crab, viewed from the right, shows how the flail drive emerges from the side of the hull and links to the geared drive at the end of the rotor by two jointed shafts. The rotor arms are fixed and no wire cutters are fitted to the ends of the rotor.**





ABOVE **One of the first station-keeping devices for flails involved four very tall posts with coloured lights on top which the following driver was trained to keep station on. The system was abandoned, however, because it prevented the turret from traversing very far.**

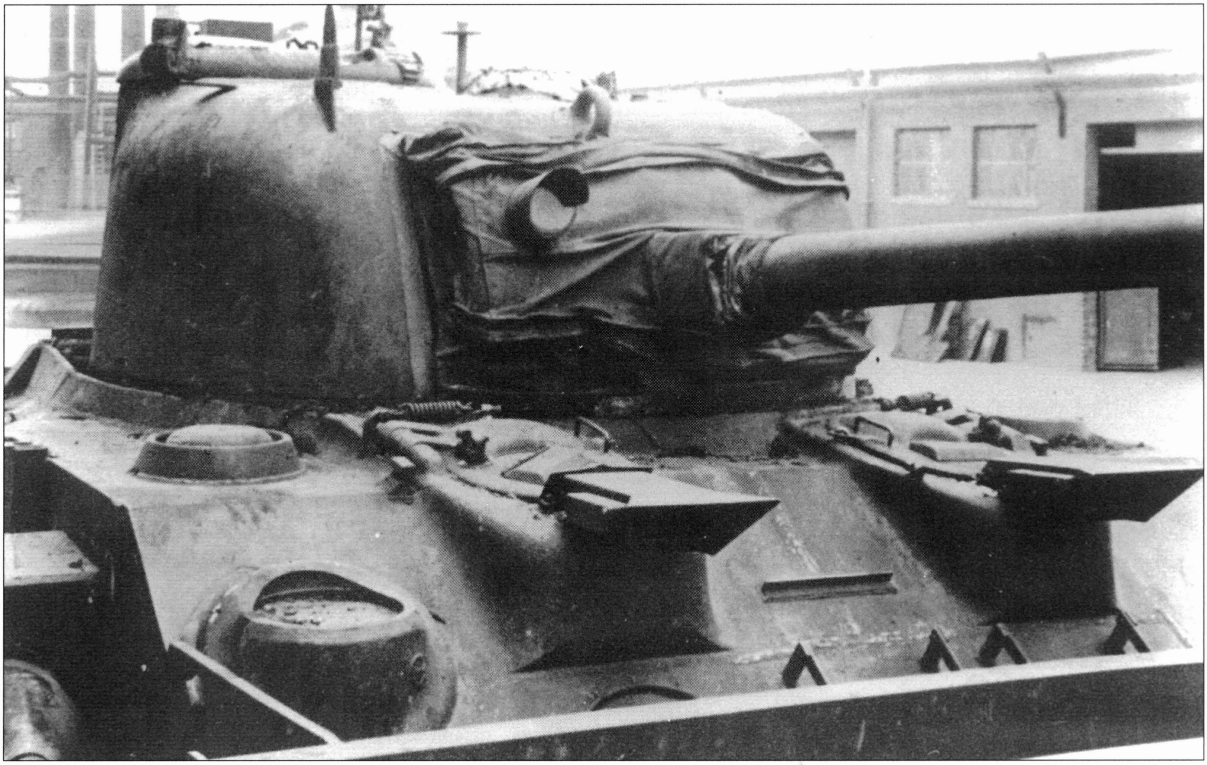
OPPOSITE **The Whyman lane-marking device was originally developed to mark out where mats had been laid over beaches, but was later taken up by the flails. Three of the long marker poles remain, which could be fired into the ground as the tank proceeded, marking the edge of the swept lane.**

trials revealed that the Crabs involved were not scoring very high figures in terms of mines destroyed in a typical flailing run. It even reached the point where a much-despised Baron put up a better show. Fortunately, before everyone went back to the drawing board, someone decided to check the quality of flail chains being supplied and discovered that many were nowhere near up to standard. As a result, those companies that could not reach the required standard were dropped and immediately the detonation rate began to rise again.

It is also worth noting that in February 1944 a Staffordshire firm, T. B. Welling & Co., submitted a flail of riveted construction, quite unlike any traditional chain, which twisted rather than broke with the blast and was regarded as promising for future development.

Contemporary official records should be the raw material from which all works such as this are created, but they are of variable value, not always to be dipped into lightly. For example, the RAC six-monthly report issued at the end of 1943 not only gives some very optimistic production figures (which reveal, among other things, that 576 Shermans earmarked for production as Marquis would now be Crabs), but also includes the extraordinary statement that Shermans fitted with Chrysler and Ford engines would not be suitable for conversion to Crabs because at least 460bhp (343kW) was required in order to drive the flail equipment. In practice, that ruled out all versions of the Sherman although, of them all, the Ford-engined M4A3 (Sherman IV) came closest at 450bhp (335kW); the Chrysler was 375bhp (279kW) as was the twin GM diesel pack, while the Continental radial was only 350bhp (261kW).

Given that the chances of the British acquiring suitable quantities of Ford-powered Shermans were slim at best, that part of the statement could be interpreted as sour grapes, yet a mere six months later the report on the Crab starts with the line; 'The Crab is based on the Sherman V…' which is, of course, the Chrysler-powered model. The report includes certain other interesting snippets. To begin with it states that, by that time, orders had been placed for 689 Crabs, but it goes on to say that RAC flail regiments were being issued with 60 Crabs each, divided between three squadrons, and that RE flail regiments are (not 'will be') issued with 40 for two squadrons of 20 each. This is the only reference seen anywhere to the use of Crabs by the Sappers at this time, so presumably it was then being considered, though in the event none ever entered service. Going back to the RAC regiments, although a very simple sum will show that they would also have 20 Crabs per squadron

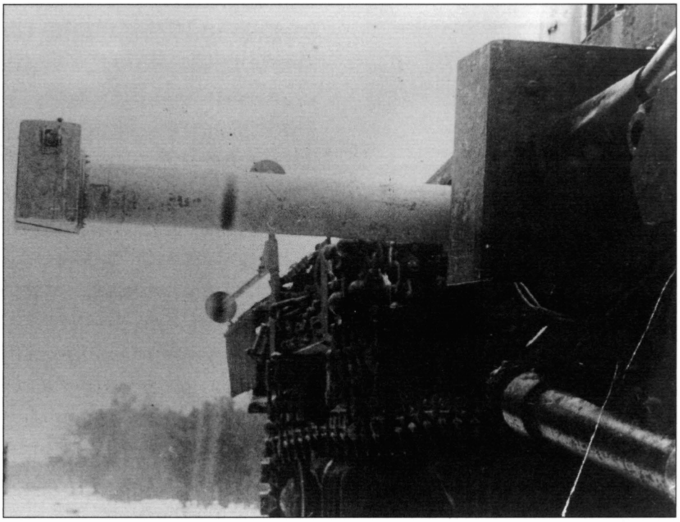


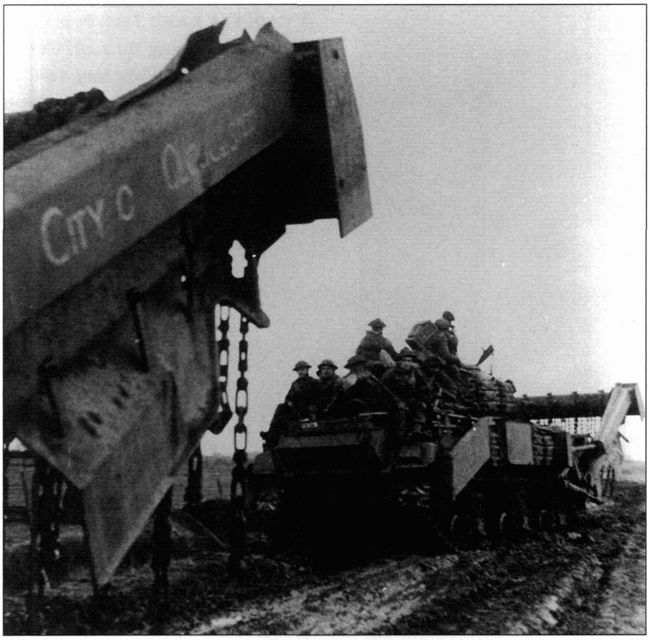
ABOVE **These extensions to the driver's and co-driver's periscopes not only helped to protect them from mud and dust, they were also marked to relate to the station-keeping equipment. This picture also gives a clear view of the special mantlet cover fitted to flail tanks to seal it from dust.**

under this arrangement, a further line indicating that these would be organized on the scale of four troops (per squadron) each of five Crabs has been crossed out in the original document.

What this tells us, of course, is that things were constantly changing and that one should be extremely cautious in interpreting an isolated entry, even in an official document. Even so, two other comments in this particular report are worth noting. The first states that all Crabs would be fitted with a hook to tow the Centipede roller device to detonate S-mines not set off by the flail. There is one poor-quality photograph showing this, presumably on trial, but no evidence that it was used in practice. The second reference is to another Sherman modification optimistically named as the Canadian Indestructible Roller Device (CIRD) which, we are told, would be issued to RAC flail regiments on the scale of one troop per squadron, to act as pilot vehicles to locate the edge of a minefield. Once again, there is no evidence that this was ever done, or indeed that CIRD saw any active service at all.

Thus far, one might say, engineering had been the driving force behind flail development, but not science. However, it seems that the Humber Company in Coventry, otherwise not known to be involved in flail development, worked out





These vehices are believed to be of the 22nd Dragoons, carrying infantry of the 51st (Highland) Division towards Blerick, on the Dutch–German border in December 1944. The name *City of Gloucester* painted on the rotor arm of the nearest Crab is probably an acknowledgement of sponsorship rather than a regimental name.

OPPOSITE **This is a station-keeping device developed by the Department of Tank Design but being tested here by F Wing, 79th Armoured Division, at Gheel in Belgium. Projecting from the side of the tank, this device uses a wire, attached to the tank in front, to activate dials that give the driver a precise indication of his position relative to the leading tank.**

that if the rotor arms could be balanced correctly, the flail could be made to follow the contours of the ground unassisted. Trials on the Marquis prototype and an early production Crab showed the possibilities and subsequent refinements by AEC evolved into an effective system.

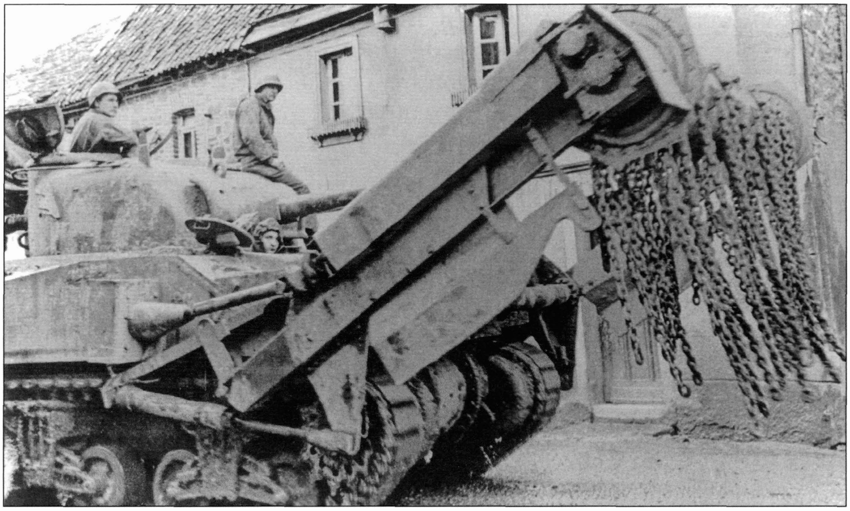
Following trials by 79th Armoured Division at the end of April, the design was authorized for production in May 1944 as the Contouring Crab, or Crab II. The type is best identified from the left, or near side in British terminology, for here one can see that the hydraulic cylinder has been removed, the rotor arm extended beyond its pivot point and a cast counterweight of about 112lb (51kg) bolted on instead. This system, aided by the centrifugal force generated by the rotor, and the weight of the rotor when the chains are in contact with the ground, kept the arm at around 4ft 3in. (1.3m) high. A stop could be engaged to keep the rotor arms level for wire cutting and the hydraulic arm on the right side, in addition to raising the arms in the normal way, acted as a form of shock absorber during flailing.

The Crab IIs, as they became available, were gradually issued to regiments in the months after D-Day. They were first used operationally at Le Havre, then at Walcheren and were the standard type by the time of the Rhine Crossing.

The Crab in action

Major-General Nigel Duncan, who commanded 30th Armoured Brigade when it operated flails, provided a very realistic picture of a typical, albeit rather formal, mine-clearing operation, written in 1947. A flail troop consisted of five tanks, on the basis that in order to clear a path 24ft (7.3m) wide through a minefield three flails would be required, plus two more waiting on the sidelines to replace casualties and provide fire support in the meantime.

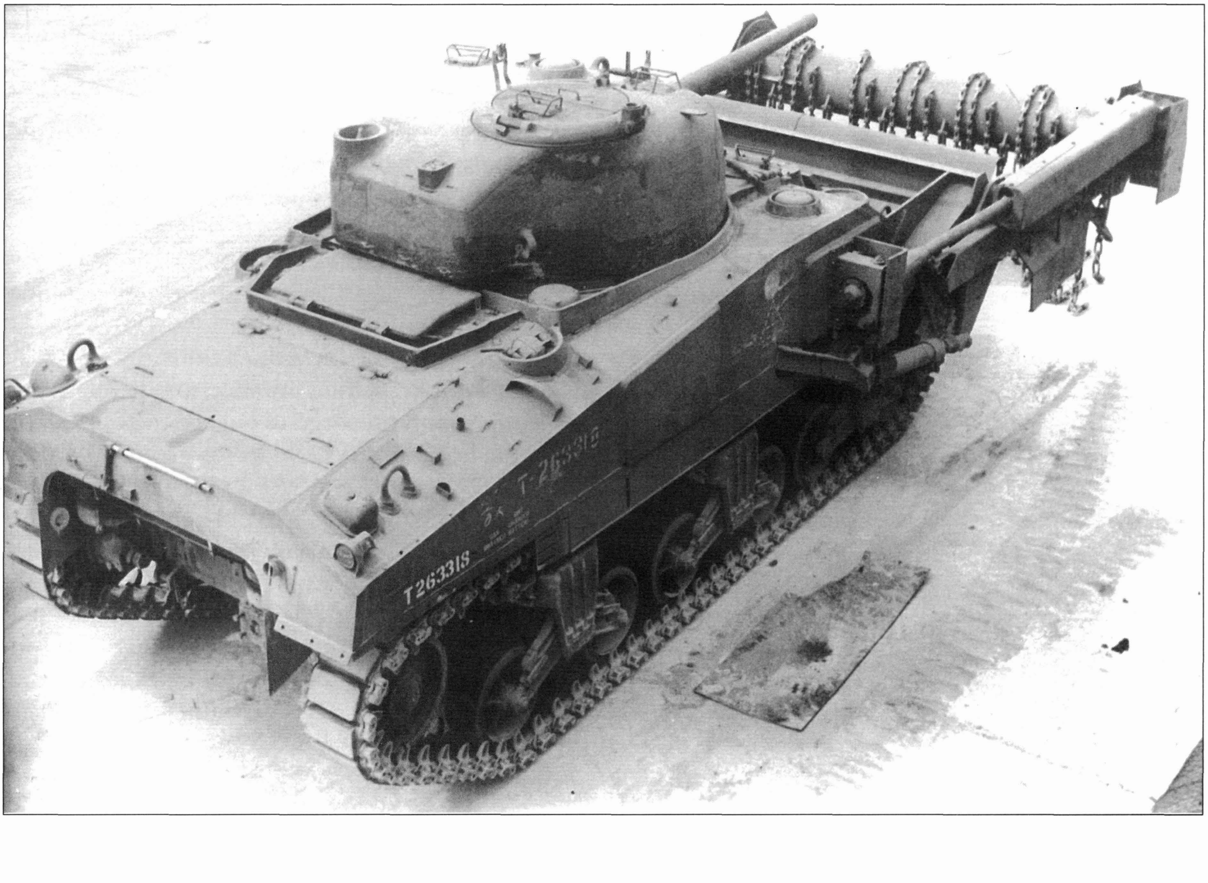
As the troop approached the edge of the minefield the three tanks earmarked for flailing formed up, one behind another, about 75ft (23m) apart, while the other two stopped and prepared to engage the opposition. At the edge of the minefield the leading tank halted, engaged the flail drive and at a steady 1½mph (2.4km/h) began to crawl forwards. The second flail then followed, still maintaining that 75ft (23m) gap but echeloned itself so that there was a 1ft (0.3m) overlap between its path and that of the leading tank. The third tank followed in the same way, and the direction of the echelon, left or right of the leader, depended on the wind direction to avoid blowing dust. The flail drum on a Sherman Crab was 9ft (2.7m) wide so, allowing for the overlap, the three could clear a lane 24ft (7.3m) wide across the minefield, this being the agreed width to suit not just conventional tanks but also other assault engineer equipment required for the operation; at all times the Crabs had to consider themselves as part of an assault team.



A Crab I of 739th Tank Battalion, US Army, passing through Vicht, Germany, on 21 February 1945. The flail chains are an early type and the bracket on the turret for smoke-bomb dischargers is a typical British fitting.

Within each tank all was concentration. A very high standard of driving was required to ensure that tanks did not wander off course, but the cloud of dust or mud kicked up by the flailing chains was almost impenetrable up to turret height, so that the driver had to rely on the elevated station-keeping devices on the tank in front. Visibility was not that good inside either. Such light as there was came filtered through a constant cloud of dust that penetrated despite the various seals applied to keep it out. The detonation of a Teller anti-tank mine was not as exciting as one might

Probably unique, a Crab I based upon the radial-engined M4 (Sherman I) which, by any calculation, should be seriously underpowered for this work. There are at least three surviving views of this machine, but no explanation as to why it was developed.

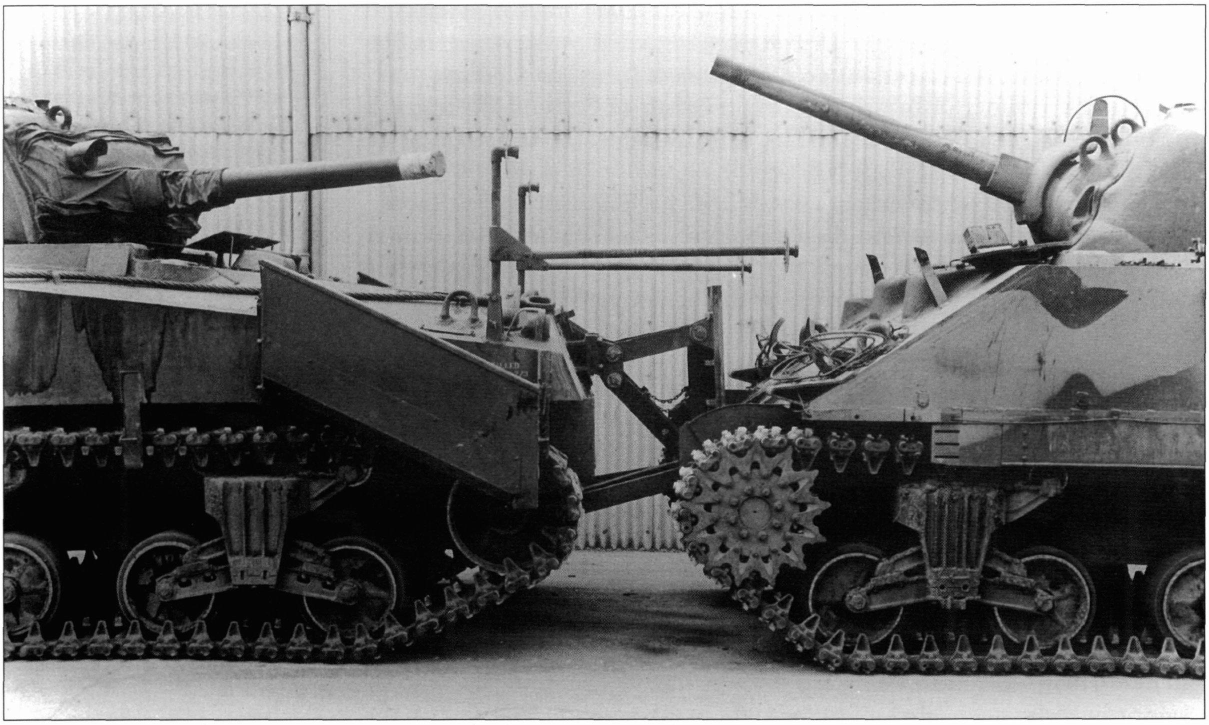


expect. Inside it sounded as a dull thud, accompanied by a slight shock running through the vehicle. More telling was a sudden increase in engine noise when the blast from the mine caused the flail jib to jump upwards so that the flail drum revved a bit faster before falling back into place.

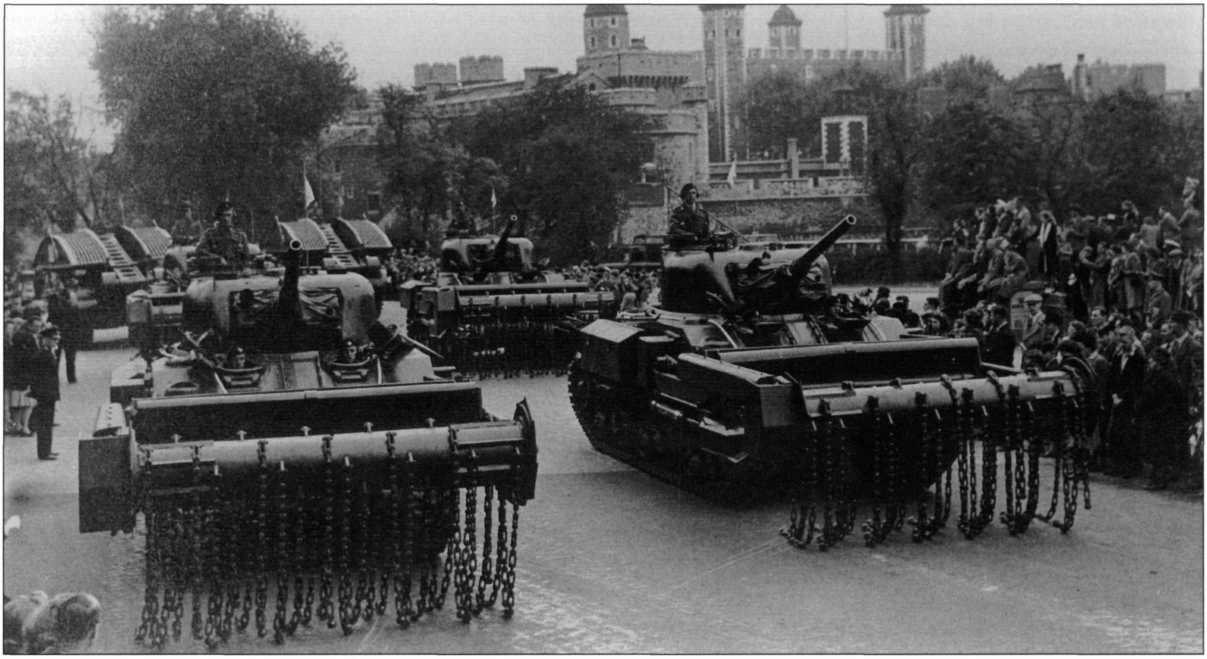
Naturally, there were many different combat considerations. Ian Hammerton, a troop commander in B Squadron, 22nd Dragoons (see Bibliography), tells how during the assault on Groesbeek in the Reichswald, his troop, echeloned to the right, had been warned of the presence of a German self-propelled gun in the neighbourhood and, feeling very exposed on a broad, treeless plateau, flailed the course with turrets trained to the right and gunners ready, just in case. On an earlier occasion, during operations to clear the Scheldt estuary, Hammerton's troop assisted the Canadians by flailing along the top of a dyke, high above the surrounding countryside, for all to see and working in the muddiest conditions imaginable. It was the kind of operation that no previous training could really have prepared them for.

Hammerton also remarks that, in the final months of the war, when the mine problem was nothing like as great as it had been, their eager new commanding officer volunteered the regiment for virtually any job going, to the point that plans were made to remove the flail equipment and have the Crabs operate as conventional gun tanks; a suggestion that was not greeted with very much enthusiasm by the specialist crews.

The Crabs also appeared in Italy in the final months of the war, forming B Squadron, 51st RTR, in the 25th Armoured Engineer Brigade; while A and C Squadrons had Crocodile flamethrowers. The Crabs saw some action during the advance to the Reno and Senio rivers, but not enough to suffer any casualties at all, and they spent the last weeks clearing routes through minefields well behind the lines.



The pusher contraption, borrowed from the Americans and fitted to a Crab II, so that another tank could bank it up steep hills. The Crab also displays station-keeping equipment and an angled marker box on each side that dispensed illuminated pegs along its route.



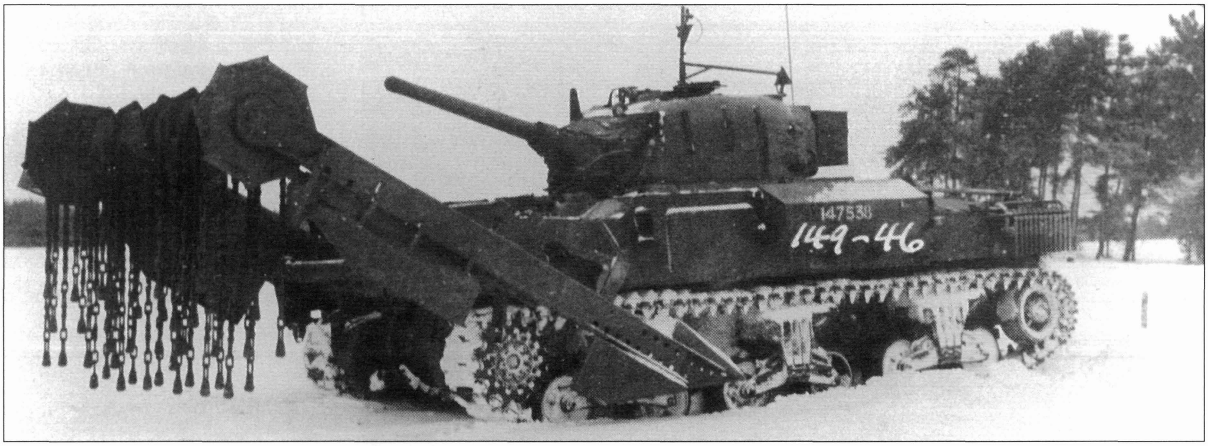
The Westminster Dragoons provided crews for four Crabs to take part in the British Victory Parade in 1946. They are shown here, in a highly polished state, formed up near the Tower of London and ready to move off, followed by a pair of Churchill bridgelayers.

THE AMERICAN ANGLE

On a number of occasions during the development of the Scorpion flail, the authorities in Washington DC asked London to supply information. Indeed, at one time they even asked for a sample vehicle. The response was not encouraging. Each time the request was rejected, on the grounds of security, which seems an odd way for Allies to behave. True, the Americans were working on their own designs, and had some flails operating in Tunisia by 1943, but clearly the British were regarded as the pioneers.

In February 1944 a committee of engineers from the US First Army examined a number of British devices on behalf of General Eisenhower, including both the Scorpion and the Crab (which they described as an American version of the British Scorpion) and one gets the impression that the Scorpion, in American eyes, killed the Crab. Two US Armored Division commanders turned the Crab down as an organic part of their divisions, largely on the grounds that it appeared to be too slow, while the First Army team had three objections: lack of mobility, meaning that it was too slow, mechanical unreliability and sensitivity to terrain, all of which suggest that it was the Scorpion that was being judged. However, they had three alternatives to suggest: the snake explosive device, the bulldozer tank and the traditional methods of lifting mines by hand, all of which they deemed more effective.

Even so, experience soon altered views and on a number of occasions British flail regiments, and particularly 2nd Lothian & Border Horse, were called upon to assist General Simpson's US Ninth Army when mines were expected, on one occasion with tragic results. On the night of 26 February 1945, two troops of A Squadron moved out to assist two tank companies of the 743rd Tank Battalion in an attack on the villages of Kich and Troisdorf. The Crabs led the way in the dark until the leading American company peeled off to the right to take up fire positions off the



Snow trials were held at Petawawa in Canada over the winter of 1948–49. This is a Crab II with the flail attachment on full elevation. The trials seemed to show that flailing in deep snow was ineffective.

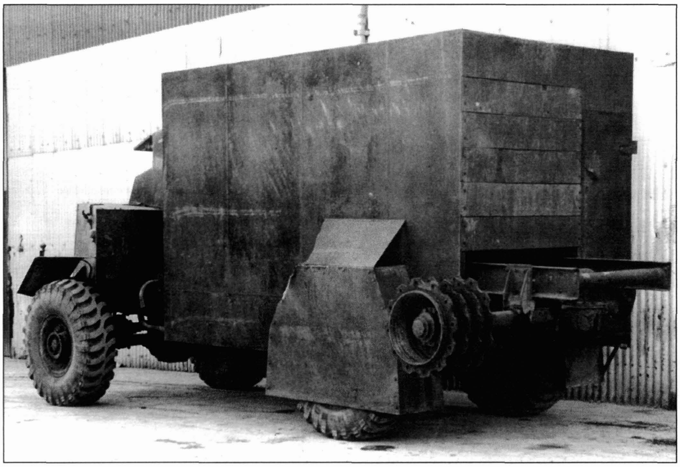
road. At this point the leading Crabs were reversing back down the road when they were spotted by tanks of the second company which, unable to recognize them in the dark, opened fire and knocked out three Crabs. Ultimately, a handful of Crabs were handed over to the Americans, where they were operated by the 739th Tank Battalion.

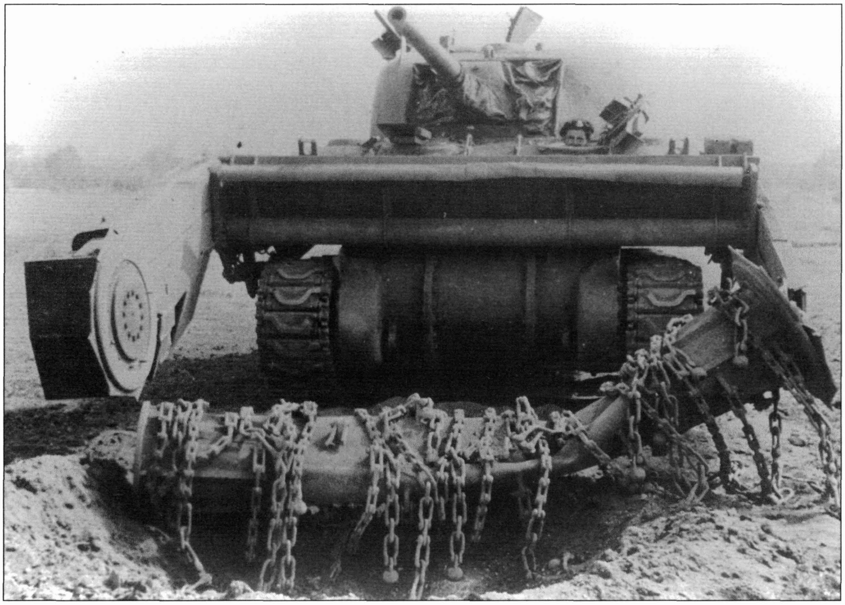
POST-WAR DEVELOPMENTS

The Crabs and their crews emerged from the war with everyone's praise ringing in their ears. They had performed a dangerous and thankless task with great competence and skill. Statistics are always difficult to play with because they never reveal the full story but, for what they are worth, the following refer to flail operations during the first four months of operations in north-west Europe. Each squadron destroyed, on average, 440 mines in an overall average flailing time of eight hours, and over the same period only 15 tanks were destroyed beyond repair through mine damage. The future was looking good.

Long term, it was intended to include a flail (FV204) as part of the Universal Tank Programme, until this collapsed in a mixture of financial melt-down and technical nightmares. In the meantime the Crab II became the focus of numerous experiments, some of the more interesting of which are shown in the photographs. One might be mentioned here since it had implications for the future. Towards the end of the war the Germans had started to counter the success of the Crab by linking conventional mines to more substantial explosive devices – aerial bombs, depth charges or large artillery shells for example. The Crab detonated the mine, the mine detonated the bomb and the bomb destroyed the Crab. This was clearly a short-term solution that might not be used after the war, but more powerful mines were very likely. To explore this possibility a Crab II was tested

The partially armoured AEC Matador flail dynamometer, with what appears to be the armoured cab of a Deacon. Projecting from the back is the sub-frame that carries a Ford engine at the front end, driving the multiple discs to which different types of flail chain could be attached.

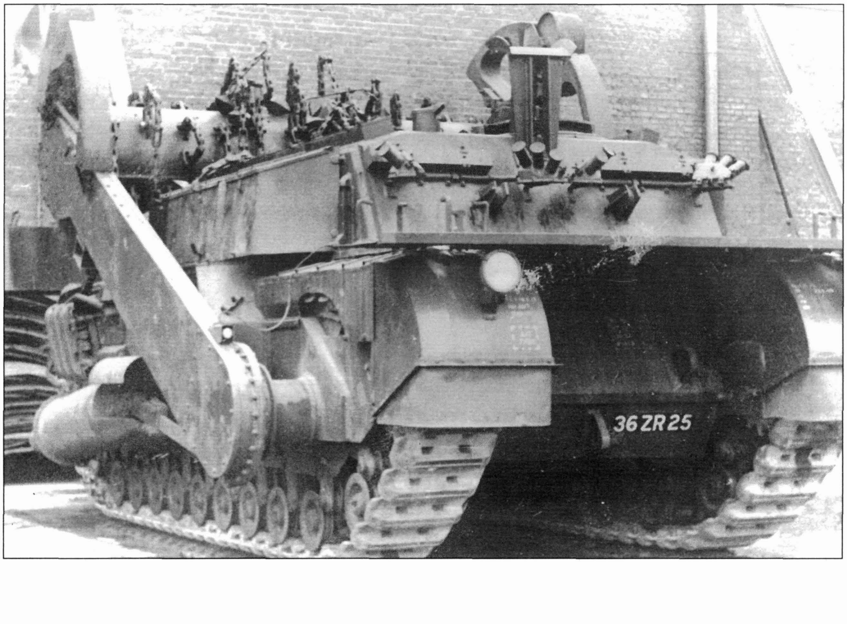




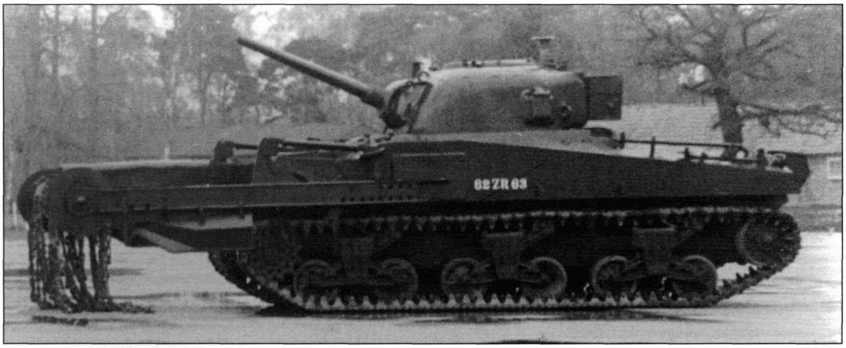
As part of the experiments to develop a post-war flail, a remote control Crab was tested against much more powerful mines. This was the result. Clearly in the future something a lot more robust would be required.

by the FVPE in 1947 against a 40lb (18kg) anti-tank mine, and the results were impressive. The FVPE staff were unwilling to risk a human crew at this stage, so the trial tank was 'manned' by a crew of rabbits, each in its own cage, and FVPE fitted a remote-control clutch so that the tank could be started from outside. The result was certainly spectacular since the mine blew off the rotor and created a large crater, but the rabbits appear to have been unharmed – at least until each one was subjected to an autopsy.

For the future, however, there was a problem to be resolved. The Sherman Crab could not go on for ever and in any case it was an American tank, technically on loan. FV204 was a non-starter and no plans had ever been made to develop a flail version of Centurion, although this might have been the better solution even now. Instead, by about 1953 (and one feels in some desperation) plans were drawn up to



A final production Churchill flail or Toad, shown with the rotor drum and arms folded backwards in the travelling position; it made a particularly tall load for a tank transporter. It enables us, however, to see the shelf across the front that reduced mud splash and, higher up, the array of smoke bomb dischargers.



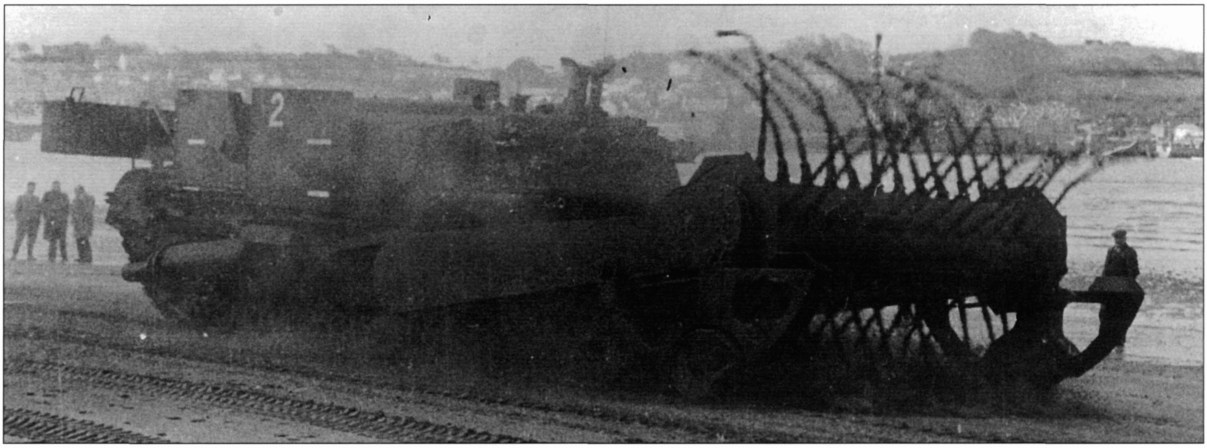
A Crab 2 with a post-1948 registration. Viewed from the left side one can see the counterweight that replaced the hydraulic gear on that side and enabled the rotor arm to follow the contours of the ground. With the vehicle on a hard surface it is evident how the added weight of the flail gear bears down on the front of the suspension.

create a flail version of the Churchill for the RE under the designation FV3902. There were still plenty of Churchills around, many in nearly new condition, and it was a type familiar to the Sappers, but as a basic design it was very long in the tooth and not, at first glance, ideally suited to such a conversion.

In total 42 Churchill Flails – or Toads as they were nicknamed – were built between 1954 and 1956 by a consortium that included the Distington Engineering Company of Cumberland (preparation of drawings and design parents), Robinson & Kershaw of Dunkinfield (hull conversion and new superstructure) and British Railways workshops at Horwich (flail mechanism and final assembly). There were three successive variants of the Toad, but the basic layout was the same and can be described first. The hull was that of a late production A22F Churchill, stripped of its turret and fitted instead with a large superstructure that covered the entire front half of the tank. At the very front, raised well above his original position, sat the driver, with the commander (the only other crew member) on his left; behind them the rest of the superstructure was occupied by the fuel-injected M120 version of the Rolls-Royce Meteor V12 (the Conqueror tank engine) aligned fore and aft but facing back to front. There was also room here for air cleaners plus fuel and lubricating oil tanks for both engines. Already it was a step backwards by introducing a separate engine to drive the flail.

To be fair, the designers were anticipating a new generation of mines that the poor old Crab would not have had the stamina to deal with (Toad was a much more powerful machine by any standards), to which end they needed a bigger rotor drum with more flails attached and, by definition, much stronger support arms. This was the most novel feature of the new design, in that the arms were pivoted against the sides of the hull in such a way that for travelling the entire flail arrangement could be folded back to rest on top of the superstructure when not required. Drive to the flail rotor ran through the left, or nearside arm.

The first two Toads, the prototypes, featured a counterbalance system for the rotor (to permit contouring) located in cylinders each side, operated by a hydraulic system that also activated the flail to and from its stowed position and retracted an ingenious lane marking device at the back. In 1955 six interim design flails appeared in which, among other things, all the hydraulic gear had been deleted. Counterbalancing was now achieved by concentric springs inside much larger cylinders, the lane-marking device became a permanent fixture and if the flail boom had to be retracted for stowing, a rope and pulley system was employed.



Flailing along the beach at COXE (Combined Operations Experimental Establishment) in North Devon, with Appledore just across the water, this Toad has been fitted with deep-wading gear. The engineers observing this trial may not have known it, but this was the twilight of the wartime flail tank.

As always, everything goes around in circles, and the final design that appeared at the start of 1956 was a re-incarnation of the Pram Scorpion. The entire counterbalance system was done away with and replaced by a pair of curved skids, fitted under each end of the rotor drum, and incorporating a castoring roller. It was as if Abraham du Toit had got his way after all.

BIBLIOGRAPHY

Birt, Raymond, *XXII Dragoons 1760–1945 The Story of a Regiment*, Gale & Polden Ltd (1950)

Fletcher, David, *Matilda Infantry Tank 1938–1945* (1994)

Hammerton, Ian C., *Achtung Minen! The Making of a Flail Tank Troop Commander*, The Book Guild (1991)

Lawson, C. C. P., and private N. Huw-Williams, *A History of the Westminster Dragoons 1901 to 1967* (1968)

The Story of 79th Armoured Division, Anon, Berlin 1945.

Woolward, private W. A., *A Short Account of the 1st Lothians and Border Yeomanry* (1946)

Flailing over frozen ground was never a very rewarding experience and it is difficult to tell whether these crews, believed to be from the Westminster Dragoons, are searching for mines the hard way or just making a fire to keep warm. The route appears to have been taped already, while the men, as usual, are wearing every variation of uniform.

COLOUR PLATE COMMENTARY

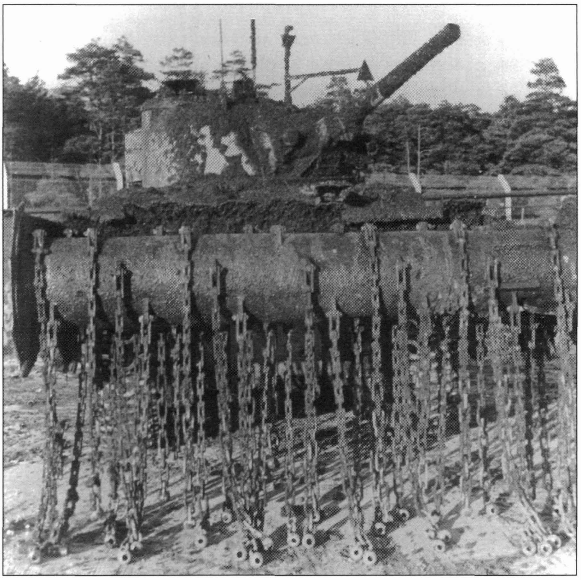
A1: VALENTINE SCORPION III, 22ND DRAGOONS, 79TH ARMOURED DIVISION, SUFFOLK, JANUARY 1944

Events moved so fast once the mine-clearing flail tank was accepted that by the time the Valentine Scorpion was entering regimental service it was already being replaced by the Sherman Crab. The 22nd Dragoons was one of six cavalry regiments revived early in the war and at this stage was senior regiment in 30th Armoured Brigade, which joined 79th Armoured Division as a flail brigade in November 1943.

Inset: This is a typical set of markings painted on the rear of the counterweight box of a Scorpion III. The well-known device of 79th Armoured Division is balanced by the unit code 51 on a red square, indicating the senior regiment in the brigade, the red/white/red recognition mark that preceded the adoption of the Allied white star, and the War Department serial number T18072, which reveals that this tank began life as a Valentine I, built by Metro-Cammell in 1939.

A2: GRANT SCORPION III, C SQUADRON, 1ST SCORPION REGIMENT, ROYAL ARMOURED CORPS, TUNISIA, APRIL 1943

The turret gun having proved useless on the Matilda Scorpion, the first Grant Scorpions were issued without turrets. At the same time the 75mm hull gun was removed because it interfered with the flail attachment and the resulting aperture appears to have been blanked off by a curved shield of armour plate. Naturally, without a turret the Grant hull was open at the top and somewhat vulnerable. The unit Light Aid Detachment fabricated a temporary overhead cover from old petrol cans and sandbags, for want of anything better, which gives the tank this rather untidy appearance. In a short time the turrets were replaced. The men, coming from the 41st RTR, still wore the RTR badge on their berets, but to display their special role they adopted the special scorpion shoulder flash in May, which was worn on the left sleeve.



Flailing in thick mud was a messy business. This thoroughly plastered Crab was being used in post-war trials to test special devices to clean periscopes using water sprays. Cleaning the tank afterwards must have been a difficult chore.

B1: GRANT SCORPION IV, NO.1 TROOP, 400 INDEPENDENT SCORPION SQUADRON, ROYAL ARMOURED CORPS, BURMA, 1945

Aurora was one of four Scorpions, accompanied by a Valentine Porcupine mine-roller pilot tank, that moved from India to the fighting front in Burma in November 1944.

Some sources suggest that in Burma a pale blue was used, instead of white, for any symbols painted on vehicles in order to reduce visibility in regions where fighting ranges were short. This cannot be confirmed, but a hint of blue has been used here on the Allied star and the tank's name and number.

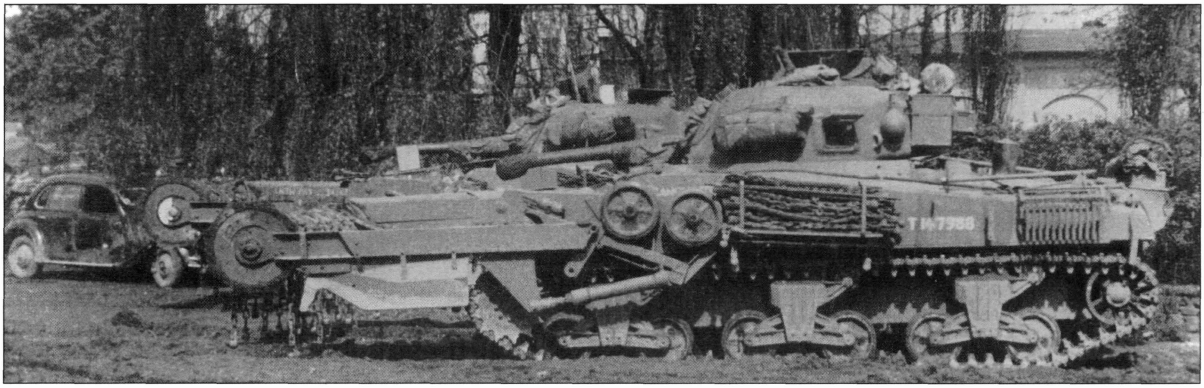
The Scorpions were attached to 254th Indian Tank Brigade, whose insignia is shown, but they never seem to have found any minefields to clear, and in any case, the close jungle environment was not always conducive to their use; *Aurora* seems to have been particularly accident prone. Notice that in this theatre the Grant Scorpions were fitted with T49 steel tracks with bar tread instead of the more common rubber block type.

B2: SHERMAN SCORPION V* (TWIN) FLAIL, B SQUADRON 'A' ASSAULT REGIMENT, AQUINO AIRFIELD, ITALY, JUNE 1944

'A' Assault Regiment was formed in May 1944 from the 1st Scorpion Regiment plus a detachment of Royal Engineers. It was to comprise A Squadron, with Churchill-based assault equipment operated by the RAC and the RE, plus B and C Squadrons with the new Sherman Scorpions, although it seems that the latter was never completed. Aquino airfield, west of Cassino, was the only location at which these flails were called upon to do any work. B Squadron supplied two troops with five Scorpions to assist an airfield construction unit, but it was soon found that the flail chains were not up to the work and when improved chains also failed, the crews resorted to clearing mines by hand. They spent ten days on this work, which included towing away wrecked German aircraft. After that there was nothing more for Scorpions to do in Italy. The insignia is that of 25th Armoured Engineer Brigade, but there is no evidence to show that it was ever actually painted on the tanks.

C1: SHERMAN MARQUIS FLAIL TANK, AEC LTD, SOUTHALL, OCTOBER 1943

Perhaps because it was so heavily overshadowed by the Crab, a good deal of detailed information on the Marquis flail has not survived. We know that the superstructure housed a crew of two, situated side by side, with a rooftop hatch to enter and exit by and standard tank periscopes to view through. What we cannot say for sure, for example, is whether a fourth crew member sat alongside the driver. Since the hull machine-gun position was masked, he may not have had a lot to do, but in any case, since the tank was never accepted for service, it is probably irrelevant. The vehicle is shown here in the final stage of production, before final painting.



A superb view of a pair of Crabs of 22nd Dragoons, fully stowed for active service. Features to note on the nearest tank are the frame for a Whyman lane marker near the back, a frame to hold spare flail chains beneath the turret and two spare road wheels near the front.

It seems reasonable to assume that the turret layout was very similar to the Valentine Scorpion and we know that the flail engines drove through single-speed gearboxes but that, unlike the Valentine, hydraulic pumps were used to raise or lower the rotor arms. The distinctive badge is that of AEC – the Associated Equipment Company of London – which built the prototype.

C2: SHERMAN V CRAB I, 22ND DRAGOONS, 30TH ARMOURED BRIGADE, NORMANDY, 6 JUNE 1944

The 22nd Dragoons put two squadrons ashore on D-Day. In Sword sector A Squadron landed with the British 3rd Infantry Division, while next door, on Juno, B Squadron was with 3rd Canadian Division. On occasions, where Sherman DD tanks were not available, the Crabs used their guns to silence the opposition. Otherwise it was a matter of clearing lanes across the beaches and through the dunes and then tackling the lateral roads. Formal operations were impossible under the circumstances; it was a time for quick and innovative thinking.

A report, issued about a week after D-Day, singled out the Crabs for high praise. Not only did they manage to clear more than 50 per cent of the required exit lanes from beaches, they also used their guns to considerable effect. It is worth saying that some senior officers were very doubtful about the value of flails on sandy beaches. They imagined that large craters would appear every time a mine was detonated, and would prove to be as big an obstacle as the mine itself; however, this does not seem to have been a serious problem. Our tank is shown storming ashore with the flail thrashing, but still sporting the special Deep Wading Gear designed to help it through deeper water; but this would be jettisoned at the first opportunity.

D: SHERMAN V CRAB I, WESTMINSTER DRAGOONS, 30TH ARMOURED BRIGADE, 79TH ARMOURED DIVISION, 1944

This cutaway has been arranged in particular to show how the drive from the tank's engine is conveyed to the rotor drum. A system of chains and sprockets takes the drive from the tank's main propeller shaft and through a narrow opening in the side of the hull. Within the tank, for safety reasons, this is all encased within a mild steel cover. Outside, the link to a jointed Cardan shaft is protected by an armoured cover and from there drive is taken forward to a gearbox at the end of the flail rotor drum.

Inside the tank things are otherwise similar to a conventional Sherman except that there are alterations to the ammunition stowage on the right side.

The other changes are two independent compass systems and a device for measuring distance travelled in yards. The most obvious compass is the binnacle compass that pokes through a hole in the top of the tank's turret and is elevated to its full height when required in order to get it as far away from the mass of metal as possible. This compass can be read via a repeater inside the turret and gives the normal magnetic bearing. The other is a gyro compass, which has to be preset in order to give the driver a precise course to follow across a minefield. The yard counter enables the driver to keep an accurate check on the distance covered.

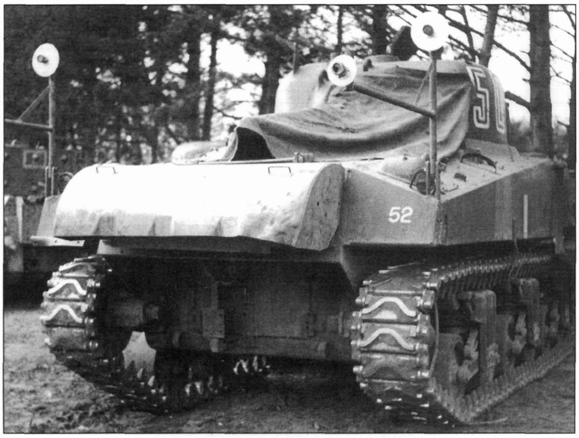
E: SHERMAN CRABS BREACHING A MINEFIELD

This somewhat idealized and simplified diagram shows a troop of flail tanks clearing a lane through an enemy minefield. Three of the five tanks are flailing steadily across the danger zone in a dead straight line at 1½mph (2.4km/h). The wind is blowing from the west and the tanks are echeloned to the right so that they are not blowing dust over the tanks behind them. They are keeping station, 75ft (23m) apart and each slightly overlapping the path of the tank in front to create a reasonably safe lane 24ft (7.3m) wide for other elements of the breaching team to follow. The other two tanks remain in reserve, using their guns to cover for those that are flailing but ready at a moment's notice to replace any flailing tank that might become a casualty. Minefields in Normandy appear to have been clearly marked to prevent German troops and local civilians from straying into them.

The full establishment for a flail regiment in 1944 is also laid out on this diagram.

F1: A SHERMAN V CRAB I, 1ST LOTHIAN & BORDER HORSE, 30TH ARMOURED BRIGADE, WINTER 1944–45

Winter was never a good time for flail tanks. Either the terrain was liquid mud that got plastered all over the tank and its crew, besides making the task of detonating mines more difficult; or it would be bitterly cold, freezing the crews even inside the tank and making the ground rock hard, which made flailing impossible. And then, of course, there was



This Crab of the 1st Lothian & Border Horse carries the most common type of station-keeping device, involving discs on posts. Subsequently the Lothians themselves developed a more effective system that used chevrons instead of discs.

snow. This tank struck a mine, and then settled in the mud that later froze. Once the area had been cleared it would be recovered and repaired.

The Lothian & Border Horse was a yeomanry regiment, like the Westminster Dragoons. Both had been armoured car companies of the Royal Tank Corps between the wars, which became fully fledged tank regiments on the outbreak of war, although for a while the Westminster Dragoons was an officer cadet training unit. Within the 30th Armoured Brigade the three flail regiments were organized in the order 22nd Dragoons, 1st Lothian & Border Horse, Westminster Dragoons.

F2: A SHERMAN V CRAB II WITH STATION-KEEPING EQUIPMENT, BRITAIN, 1945

The problems of station-keeping for flail tanks in action exercised many minds and resulted in various solutions. However, nothing teaches so well as experience, and the chevron device shown here seems to have originated with an idea by the Lothian & Border Horse. The theory was that the driver of a following tank had to line up two chevrons so that he could see an X through his periscope. A similar structure on top of the turret could be observed from the tank in front, from a periscope in the commander's hatch. In order to indicate the safe path to following vehicles, lane markers were fired at regular intervals from special dischargers on the side of the hull. The binnacle compass can also be seen on top of the turret.

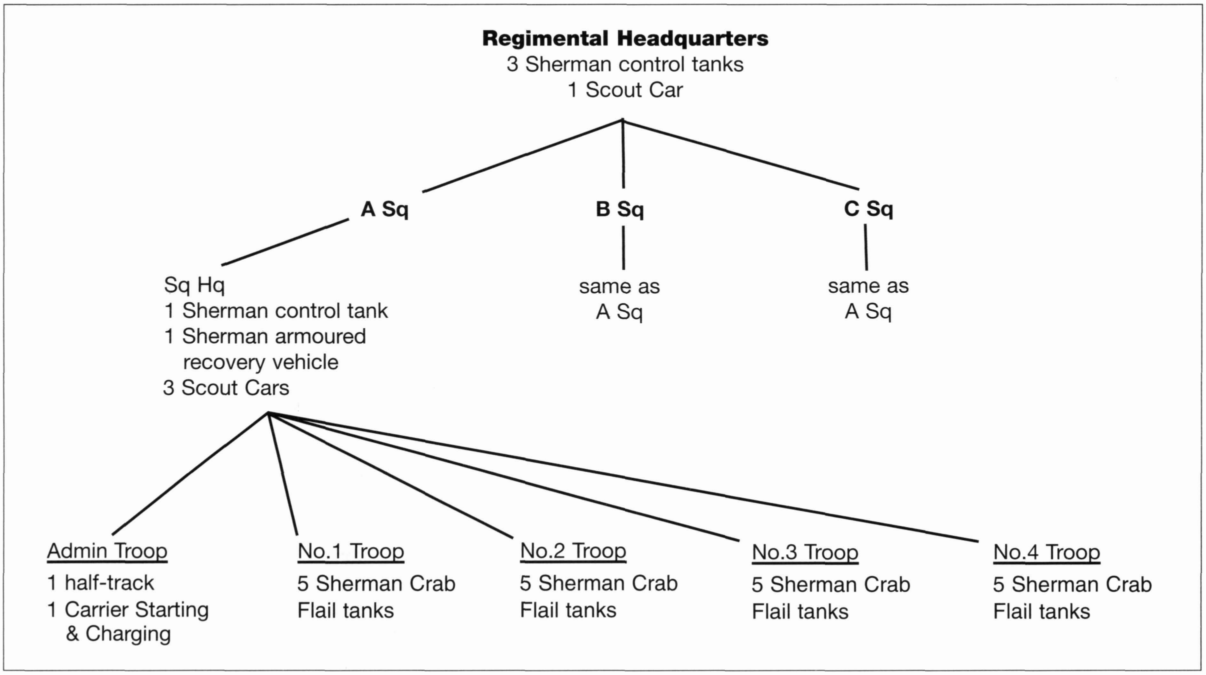
Experiments continued into the immediate post-war years and the agency involved was a truncated team from 79th Armoured Division, using the same insignia, and now known as SADE, the Specialised Armour Development Establishment.

G: A CHURCHILL TOAD FLAIL, ROYAL ENGINEERS, SALISBURY PLAIN, 1958

There is no evidence available to show whether Churchill flail tanks were ever issued for operational use, but it seems unlikely. In the main they would have been kept in store. For the purpose of this illustration we are imagining a demonstration on the British Army training area of Salisbury Plain in Wiltshire. For this reason no markings are shown on the tank itself. The end of the lane-marking dispenser is shown raised so that the mechanism can be seen and an individual marker is shown inset.

Compared with wartime flails, the Toad was immensely powerful; indeed the driver was instructed to get the vehicle moving before the flail was activated, otherwise it was found that the flail chains excavated a hole which the tank, as soon as it moved, fell into. By the late 1950s virtually all specialized armour was operated by the RE, whose post-1953 cap badge is shown.

Organization; Flail regiment royal armoured corps



Regimental Headquarters
3 Sherman control tanks
1 Scout Car
A Sq
B Sq
C Sq
Sq Hq
1 Sherman control tank
1 Sherman armoured recovery vehicle
3 Scout Cars
same as A Sq
same as A Sq
Admin Troop
1 half-track
1 Carrier Starting & Charging
No.1 Troop
5 Sherman Crab Flail tanks
No.2 Troop
5 Sherman Crab Flail tanks
No.3 Troop
5 Sherman Crab Flail tanks
No.4 Troop
5 Sherman Crab Flail tanks

INDEX

References to illustrations are shown in **bold**. Plates are shown with page and caption locators in brackets.

AEC (Associated Equipment Co.) Ltd 7, 13, 15, 18, 19, **C1** (27, 45–46), 37
  Matador flail dynamometer **41**
Appledore **44**
Aquino airfield, Italy **B2** (26, 45)
Auchinleck, Gen Claude 4, 7, 9

Bailey Bridge 12, 23
Berry, Maj Norman 4–5, 9
Bovington 7–8
British Army
  'A' Assault Regt, B Sqn **B2** (26, 45)
  Armoured Bde, 30th 14–15, 23, **A1** (25, 45), **C2** (27, 46), **F1** (31, 46–47), 37
  Armoured Bde, 79th **D** (28–29, 46)
  Armoured Div, 7th 5, 6
  Armoured Div, 79th **10**, 12, **A1** (25, 45), 37
    F Wing **37**
  Armoured Engineer Bde, 25th **B2** (26, 45), 39
  Division, 51st (Highland) **37**
  Dragoons, 22nd **10**, **A1** (25, 45), **C2** (27, 46), **37**, **46**, 47
    B Sqn 39
  Independent Scorpion Sqn, 400th 22–23
    No.1 Troop **B1** (26, 45)
  Independent Scorpion Sqn, 401st 22
  Indian Tank Bde, 254th **B1** (26, 45)
  Lothian & Border Horse, 1st **F1** (31, 46–47), **47**
  Lothian & Border Horse, 2nd 40–41
  New Zealand Div, 2nd 21
  regiment, flail tank, establishment **E** (30, 46)
  Royal Armoured Corps (RAC) **B1** (26, 45), 35–36
    No.1 Assault Sqn 12
  Royal Electrical and Mechanical Engineers (REME) 5, 12
  Royal Engineers (RE – 'Sappers') 5, 6, 7, 23, **G** (32, 47), 35, 43
  Royal Tank Regt, 41st (later 1st Scorpion Regt) 19–20, **A2** (25, 45)
    A Sqn 19, 21
    B Sqn 19, 23
    C Sqn 21, 22, 23, **A2** (25, 45)
  Royal Tank Regt, 42nd 5
  Royal Tank Regt, 43rd 12
  Royal Tank Regt, 44th 5
  Royal Tank Regt, 51st 39
  Scorpion Regt, 1st *see* British Army: Royal Tank Regt, 41st
  Westminster Dragoons **D** (28–29, 46), **40**, **44**, 47
  Workshop, No.4 Ordnance 4, 5
  Workshops, No.7 Base Ordnance 5, 21, 24
  Workshops, No.3 Base 22
British Railways workshops, Horwich 43
Burma **B1** (26, 45)
Butler (Samuel) Ltd 17

Chilwell Ordnance Depot 15
Churchill bridgelayer **40**
Churchill flail (FV3902 – 'Toad') **G** (32, 47), **42**, 42–44, **44**
Covenanter tank 8
COXE (Combined Operations Experimental Establishment) **44**
Crusader tank 8
Curran Brothers, Cardiff 12, 34
developments, post-war 41–44
developments in Britain 7–15
Distington Engineering Co. 43
du Toit, Capt Abraham 4, 7, 9, 10, 16, 44
Duncan, Maj-Gen Nigel 37–39

Eisenhower, Gen Dwight D. 40
El Alamein, battle of (1942) 6–7

Fighting Vehicle Proving Establishment (FVPE) 15, 41–42
flail development, Crab **15**
flail device, self-contained (Perambulator device) 9–10, 16
flails, early 4–5, 7–8
FV204 flail 41, 42

Galpin, Maj S. G. 7, 8
German army, Panzer Division, 21st 5
Grant Scorpion flail 20–21
Grant Scorpion II **20**
Grant Scorpion III **17**, 21–22, **A2** (25, 45)
Grant Scorpion IV **22**, 22, **23**, 23, **B1** (26, 45)
Groesbeek assault 39

Hammerton, Ian 39
Hibberts (J.) Ltd 34
Hobart, Gen 15–16
Humber Company 36–37

Italy **B2** (26, 45), 39

Jones, T. C., & Co. 14, 34

Kich 40

Landing Craft, Tank (LCT) (4) **13**, **23**
lane–marking devices **35**, **39**, **46**, 47
Le Havre 37
London, Tower of **40**
lorry, Canadian Ford 4, 5

markings **A1** (25, 45)
Matilda Baron flail 8–12, 15, 18, 35
  prototype **8**, 9
  wheeled version 10
Matilda Baron Mark III 10
Matilda Baron Mark IIIA **9**, 10–12
Matilda Infantry Tank, A12 5
Matilda Scorpion I flail **4**, 5, 6–7, 19
Matilda Scorpion II **6**, 7, 19, 21
Milner's Safe Company 34
Mine Springing Device, Anti-Tank 4
minefield, breaching **E** (30, 46)
mines, anti-personnel S 14, 36
mines, Teller anti-tank 14, 38–39
Montgomery, Gen Bernard 5

Normandy **C2** (27, 46)

Operation *Husky* 22, 23
O'Shaughnessy, Capt 7, 8

Paterson, Maj 8
periscope extensions **36**
prototypes 15–19
pusher contraption **39**

Rackham, George J. 7, 10, 11, 15, 16, 18, 33, 34
Rhine Crossing 37
Robinson & Kershaw 43
Roller Device, Canadian Indestructible (CIRD) 36
roller device, Centipede towed **10**, 14, 19, 36
Rollers, Fowler 5
Rommel, Gen Erwin 3

Samuel Butler Ltd 17
Scheldt estuary operations 39
Scorpion flail tanks 19–24, 33
  see also individual entries
  British 8, 12–15, 16, 40
Sherman Crab flail tanks
  in action 37–39, 41
  early trials 18
  production commences 34
  prototype 19, 33–34, **34**
  Sherman V Crab **3**, **24**, **25**, **E** (30, 46), **37**, **40**, **44**, **45**, **46**, **47**
    City of Gloucester **37**
  Sherman V Crab I **21**, **C2** (27, 46), **D** (28–29, 46), **F1** (31, 46–47), **38**
  Sherman V Crab II **24**, **F2** (31, 47), **41**, 41
    remote control 41–42, **42**
  Sherman V Crab II (Contouring Crab) 37
  Sherman V Crab 2: **43**
  Sherman Crab I, M4 based **38**
  in US service 40–41
Sherman Lobster flail **16**, 18–19
Sherman Marquis (Octopus) flail 15, 18, **19**, **C1** (27, 45–46), 34, 37
Sherman Pram Scorpion flail 16–17, **18**, 44
Sherman (M4A4) Scorpion V flail **20**, 24, 33
Sherman Scorpion V (Twin)/V* flail 24, **B2** (26, 45)
Sherman tanks 16, 35
  Sherman I (M4) 34
  Sherman IV (M4A3) 35
  Sherman V (M4A4) 33, 35
Sicily landings 22, 23
snow trials **41**
South African Army, 21st Field Coy, South African Construction Coy 5
Specialised Armour Development Establishment (SADE) **F2** (31, 47)
station-keeping devices **F2** (31, 47), **35**, **37**, **39**, **47**
Sutton, G. J. 8

Takroum 21–22
Tobruk 3
Troisdorf 40

Universal Tank Programme 41
US Army
  First and Ninth Armies 40
  Tank Bn, 739th **38**, 41
  Tank Bn, 743rd 40

Valentine Mark II/III (Infantry Tank Mark III) 13
Valentine pilot tank 19, 22, **B1** (26, 45)
Valentine Scorpion **10**, 13–15, 18
Valentine Scorpion III **13**, 14–15, **A1** (25, 45)
Vicht, Germany **38**
Victory Parade, 1946 **40**
Villers-Bretonneux **33**

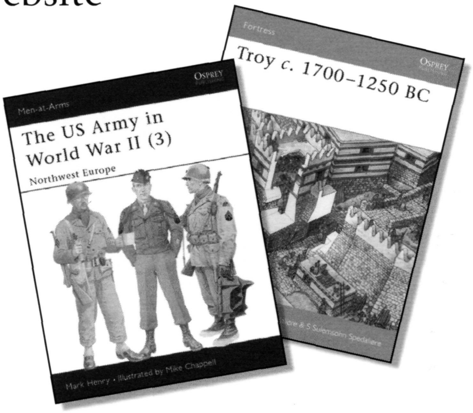
Wading Gear, Deep **C2** (27, 46)
Walcheren 37
War Office 7, 15, 19
weather conditions **F1** (31, 46–47), **41**, **44**, **45**
Welling, T. B., & Co. 35
Western Desert 3
wire, dealing with 11, 24

Related Titles

ISBN	SERIES	No.	TITLE
978 1 85532 296 7	New Vanguard	3	Sherman Medium Tank 1942–45
978 1 85532 457 2	New Vanguard	8	Matilda Infantry Tank 1938–45
978 1 85532 547 0	New Vanguard	15	Flammpanzer German Flamethrowers 1941–45
978 1 84176 542 6	New Vanguard	73	M4 (76mm) Sherman Medium Tank 1943–65
978 1 84176 923 3	New Vanguard	115	Landing Ship, Tank (LST) 1942–2002
978 1 84176 983 7	New Vanguard	123	Swimming Shermans
978 1 84603 083 3	New Vanguard	136	Churchill Crocodile Flamethrower
978 1 84176 366 8	Campaign	105	D-Day 1944 (3) Sword Beach & the British Airborne landings
978 1 84176 368 2	Campaign	112	D-Day 1944 (4) Gold & Juno Beaches
978 1 84176 901 1	Battle Orders	20	Rommel's Afrika Korps
978 1 84603 006 2	Battle Orders	23	Desert Raiders: Axis and Allied Special Forces 1940–43
978 1 84176 761 1	Fortress	23	German Field Fortifications 1939–45
978 1 84176 842 7	Elite	124	World War II Infantry Anti-Tank Tactics
978 1 84176 052 0	Men-at-Arms	354	The British Army 1939–45 (1) North-West Europe
978 1 84176 237 1	Men-at-Arms	368	The British Army 1939–45 (2) Middle East & Mediterranean

Visit the Osprey website

- Information about forthcoming books
- Author information
- Read extracts and see sample pages
- Sign up for our free newsletters
- Competitions and prizes

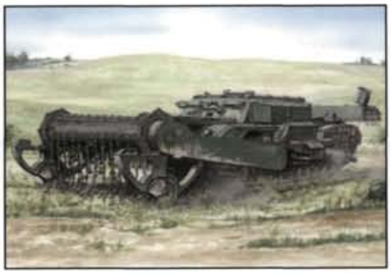

Fortress
Osprey
Troy c. 1700–1250 BC
Men-at-Arms
Osprey
The US Army in World War II (3)
Northwest Europe
Mark Henry • Illustrated by Mike Chappell

www.ospreypublishing.com

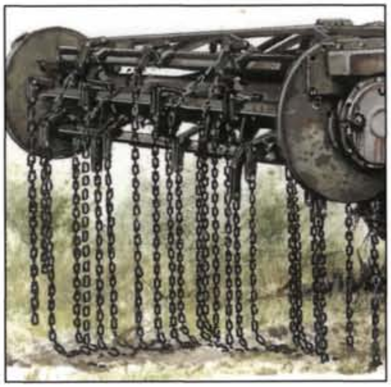
To order any of these titles, or for more information on Osprey Publishing, contact:
Osprey Direct (North America) *Toll free:* 1-866-620-6941 *Fax:* 1-800-659-2436 *E-mail:* info@ospreydirect.com
Osprey Direct (UK) *Tel:* +44 (0)1933 303820 *Fax:* +44 (0)1933 443849 *E-mail:* info@ospreydirect.co.uk
www.ospreypublishing.com

New Vanguard • 139

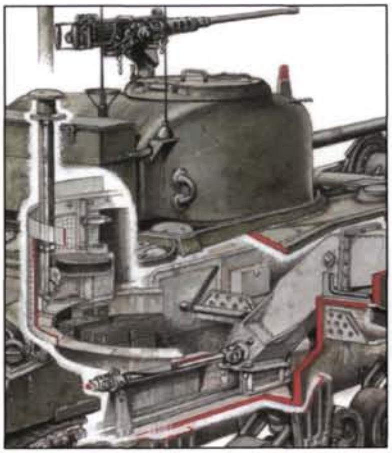
The design, development, operation and history of the machinery of warfare through the ages



Full colour artwork



Unrivalled detail



Cutaway artwork

Photographs

Sherman Crab Flail Tank

The anti-mine flail was a cumbersome and temperamental, almost comical machine, yet was to play a notable part in World War II mine-clearing operations. The idea of a tank-mounted flail arose during the North African campaign and ad hoc designs saw action whilst the idea was taken to Britain for development. David Fletcher details the development of several variants of the flail, including Matildas, Valentines, Grants, and, of course, Shermans. Using rare photographs and colourful artwork, he also outlines the deployment and limitations of these tanks, and describes the action they saw, noisily beating their way across minefields.

US $15.95 / $21.00 CAN

ISBN 978-1-84603-084-0

OSPREY
PUBLISHING

www.ospreypublishing.com